OFFICIAL PUBLICATION

JOURNAL

Heating • Refrigerating • Air Conditioning • Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

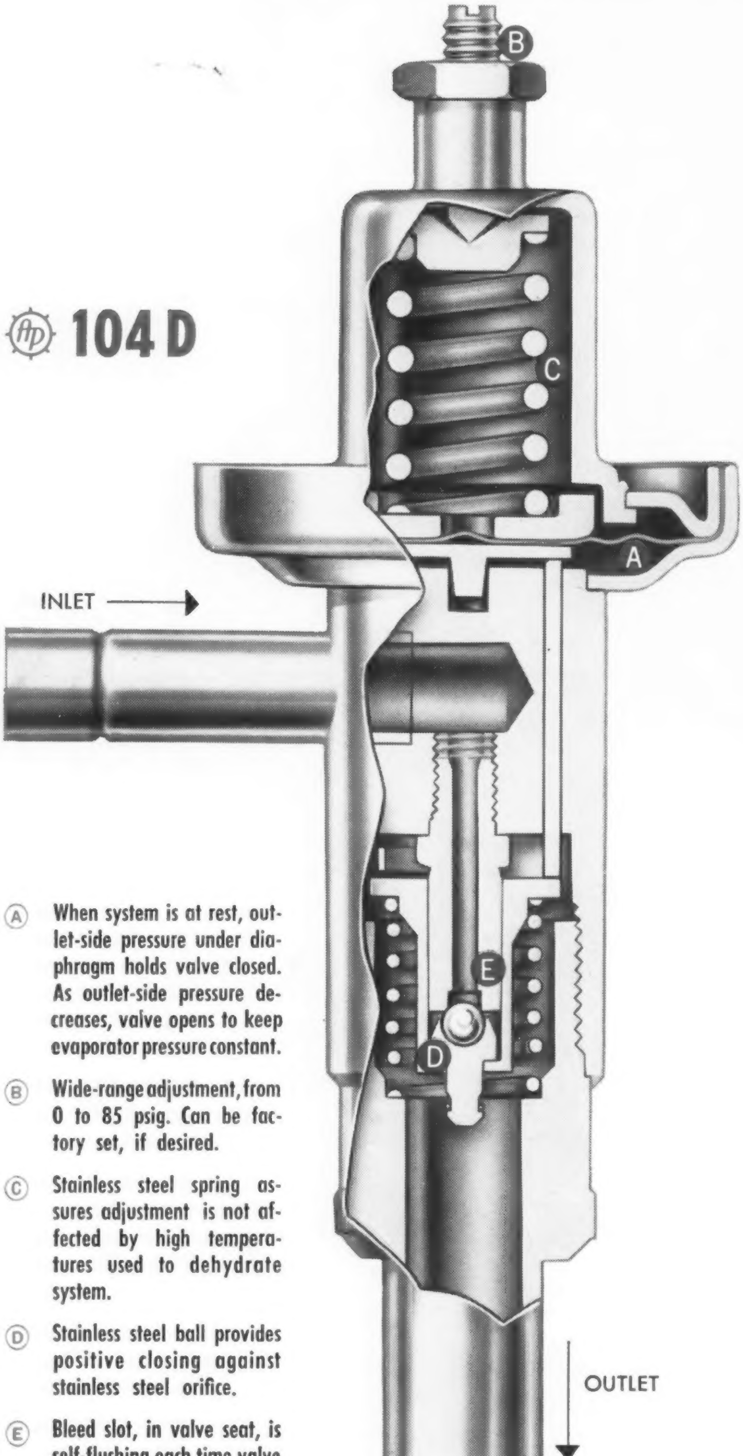
Dan D. Wile succeeded Arthur J. Hess as President of ASHRAE at the Semiannual Meeting in Dallas. His message to members appears on page 58 of this issue.

FEBRUARY 1960

NEW CONSTANT PRESSURE VALVE

cost-designed for volume production ends evaporator frosting

104 D



Ⓐ When system is at rest, outlet-side pressure under diaphragm holds valve closed. As outlet-side pressure decreases, valve opens to keep evaporator pressure constant.

Ⓑ Wide-range adjustment, from 0 to 85 psig. Can be factory set, if desired.

Ⓒ Stainless steel spring assures adjustment is not affected by high temperatures used to dehydrate system.

Ⓓ Stainless steel ball provides positive closing against stainless steel orifice.

Ⓔ Bleed slot, in valve seat, is self-flushing each time valve opens.

Used on room air conditioners by these leading manufacturers—

CARRIER • EMERSON • FEDDERS
RCA WHIRLPOOL • WELBILT
YORK DIVISION BORG-WARNER

Eliminates build-up of frost on the evaporator regardless of load. Manual shut-off for defrosting is never necessary. Cooling is continuously effective.

INSTANT COOLING ACTION

Valve bleeds off the high side pressure during off periods — within the 2-minute UL requirement. Starting overloads are avoided, even with low-torque motors. However cooling action begins without delay because valve is closed during off cycle. Valve opens as required to keep evaporator pressure constant.

In addition to room air conditioners, the 104D is ideal for beverage and food cooling units. *At volume production costs,* it is also your best choice for water coolers (no freeze-up of water in the cooler), dispensers for cold beverages and foods, ice cream cabinets, bottle and milk coolers, dehumidifiers.

CUTS SERVICE PROBLEMS

Controls Company of America's AP valves, designed with a wealth of specialized experience, virtually eliminate service problems. Their performance puts more consumer sales appeal into your product.

Should your product require it, our controls engineers will design a special valve — or other control — to meet its particular demands. In solving any controls problem, Controls Company of America offers you unequaled engineering service.

Creative controls for industry

CONTROLS COMPANY OF AMERICA

2456 N. 32nd St., Milwaukee 10, Wis. • *Cooksville, Ont.,* • *Postfach 313, Zug, Switzerland*

Electrowheel*®

another LAU "first in the industry"

Here's another Lau first, designed to help solve those cramped space blower installation problems. The versatile Lau "Electrowheel" is recommended for use whenever air moving efficiency is a requirement but space limitations present a problem. The "Electrowheel" is extremely efficient when operating where the utmost in compactness and smooth, quiet operation is required.

Lau "Electrowheel" features include stationary rubber mounted shaft, sealed ball bearings, rigid one piece motor mounts, 30″ motor leads with BX connector and the same high standard of quality found in every Lau engineered product. One moving part assures years of trouble-free service.

When an installation requires a high performance blower the Lau "Electrowheel" is the logical answer. Write for Lau Catalog LSO-463 for complete information.

** So named because a high quality external-rotor motor forms the wheel hub . . gives you more air delivery in a small package than ever before possible!*

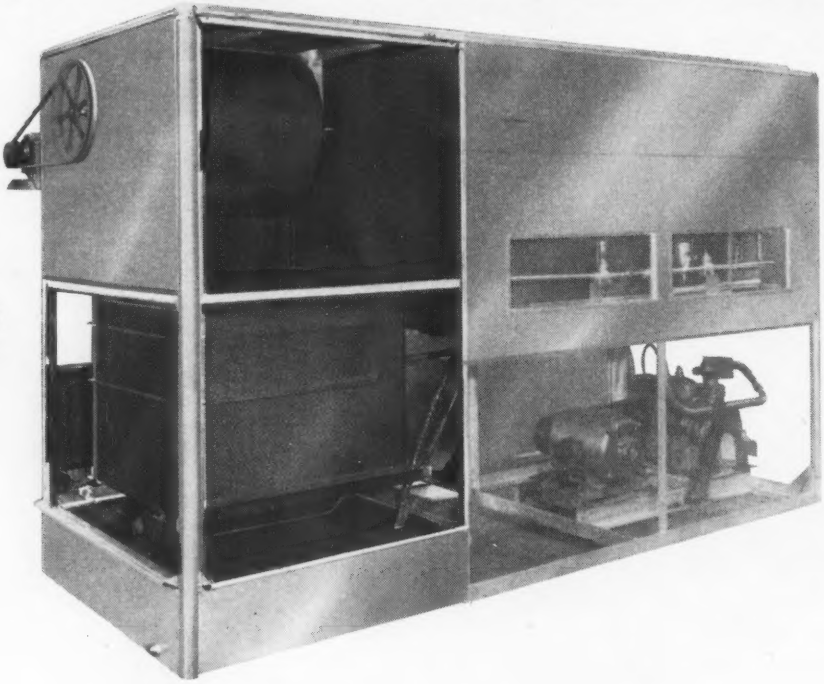
THE LAU BLOWER COMPANY, 2027 Home Avenue, Dayton 7, Ohio

LAU

World's Largest manufacturers of Air-Conditioning Blowers for

THE ULTIMATE
IN QUALITY
AND PERFORMANCE

SPECIFY PROLONGED LIFE!

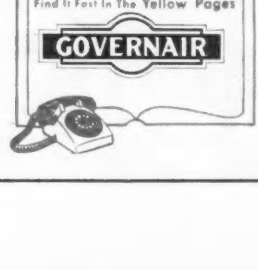


Governair's COPPER FITTED EVAPORATIVE CONDENSER

FEATURES:

ALL COPPER AND BRASS water pan, float valve, condenser coil, spray tree, eliminators, blower scrolls. Standard galvanized blower wheels and stainless steel shaft.

WRITE FOR COMPLETE INFORMATION



You have a definite feeling of confidence when you specify Governair's COOPER-FITTED evaporative condenser with its many fine features.

ALL spray water is contained within a COPPER WATER JACKET. This exclusive DOUBLE WALL CONSTRUCTION assures product longevity and lower maintenance. In fact, throughout the entire unit, you find QUALITY . . . with no worry about faulty galvanizing or temporary corrosion protection.

You also have an extremely WIDE SELECTION, as this evaporative condenser is supplied for REMOTE installation or as an integral part of Governair Corporation's self-contained PACKAGED equipment . . . Conventional; Multi-Zone (as pictured); and Water Chillers.

GOVERNAIR

4840 N. SEWELL • OKLAHOMA CITY

FEBRUARY 1960

VOL. 2 NO. 2

JOURNAL

OFFICIAL PUBLICATION

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

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Audit Bureau of Circulations

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Hughes Printing Company, East Stroudsburg, Pa.

The ASHRAE does not necessarily agree with statements or opinions advanced in its meetings or printed in its publications.

Comment

WHY DON'T YOU . . . ?

We have a soft place in our heart, or head, for the fellows who greet the Editor with suggestions. Partly, because we claim no monopoly upon worthwhile ideas for improving the JOURNAL or its service to member-readers. Partly, because such observations reveal that we do have readers and that they do care, one way or the other, about their Society publication. That not all of such suggestions, however worthy, can be incorporated within the paper should be no obstacle to their considered expression.

However, we confess to a shade of annoyance when the Why Don't Yous point toward the furthering of things which would promote the personal or business interests of the man who inquires.

If there is any one thing the official publication of a professional engineering Society should do it would seem to be the furthering of the combined status of the art and of the group allied with it. The selfish interests of individuals (however legitimate) must be subordinated to those of the whole.

All of which is so fundamental, even self-evident, as to require or deserve little exposition. Yet the thing repeatedly happens and always behind a plausible front of some sort.

Within the past week we had a potential author who wanted a feature write-up for a product he had brain-childed. Again, there was a news story waiting acceptance that would publicize the activities of a merchandising-minded group. And we think of the booster who wanted a really big obituary notice for the man who had given him his first job.

So it goes.

HOW CAN WE KNOW . . . ?

Then, there are a few who would admonish the Editors for not covering events of which they could scarcely have been aware.

In a Society such as ASHRAE, which now has nearly a hundred Chapters, it is not conceivable that some things will come to the attention of the Editors unless they are prepared specifically as news facts and submitted. Each Chapter should have some individual appointed to the duty of keeping the Editor informed of significant happenings, doing so promptly after the event and writing of highly tangible facts.

AND A SINCERE HOPE . . .

We wish that more of our good friends who have honest personal views regarding the technical adequacy, competency or discretion displayed by the authors of Meetings papers or of contributions to the JOURNAL would write us letters on the specific subject.

There is nothing like intelligent airing of the facts to clarify a doubtful situation and scarcely anything so deplorable as the competent observer who neglects to share his knowledge of important differences or righteous indignation with those less well informed.

Edward R Searles
Editor

Engineering the temperature...

WITH RECOLD IN THE LOS ANGELES SPORTS ARENA

The new 22,400-seat Memorial Sports Arena establishes Los Angeles as the sports capital of the nation. Recold units supply over 672,800 CFM of heating and air conditioning for this vast building.

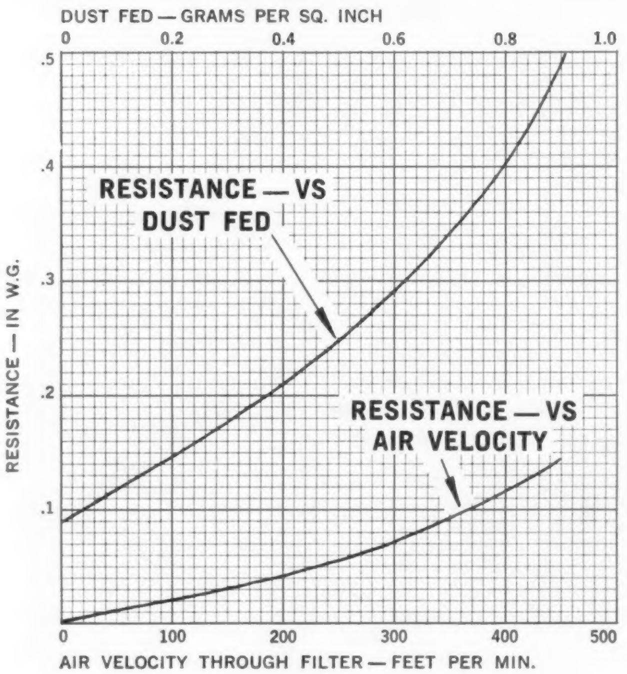
RECOLD **CORPORATION**
7250 East Slauson Avenue, Los Angeles 22, Calif.

RECOLD

Designed by: Welton Becket & Associates, Architects & Engineers
Air-Conditioning Installed by Western Air & Refrigeration, Inc.

New FRAM® permachem-treated

add a totally new dimension to air cond

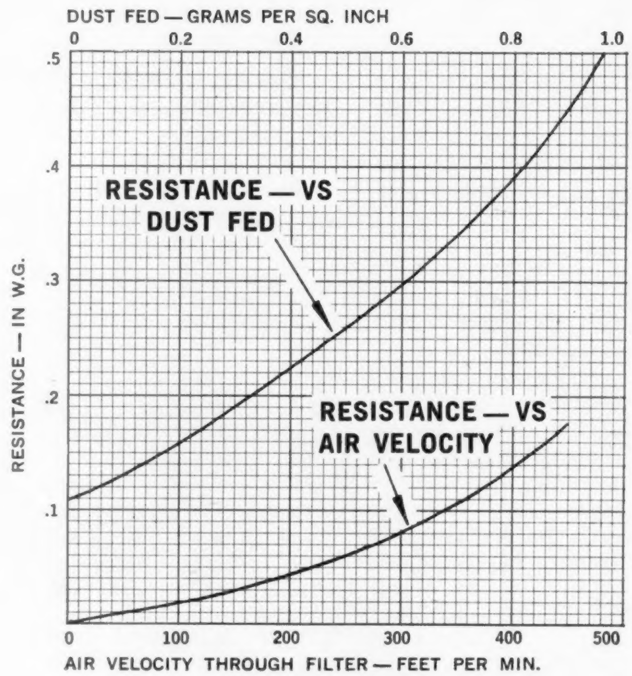


Contaminant Efficiency and Capacity Test
FRAM permachem-treated Air Filter
1″ DISPOSABLE (DRY TYPE)

TEST CONDITIONS: (FRAM Procedure #955)

1. Resistance vs. Dust Fed determined at constant air velocity of 350 F.P.M.
2. Contaminant Feed Rate is .0185 grams per min. per sq. inch. Contaminant is standard A.F.I. Test Dust consisting of
   72% Fine Air Cleaner Test Dust (Road Dust)
   3% Cotton Linters Wiley Mill Ground (Lint)
   25% K-1 Carbon Black (Soot)

TEST RESULTS:
Efficiency — 65.7%
Dust Holding Capacity — .59 grams per sq. inch



Contaminant Efficiency and Capacity Test
FRAM permachem-treated Air Filter
2″ DISPOSABLE (DRY TYPE)

TEST CONDITIONS: (FRAM Procedure #955)

1. Resistance vs. Dust Fed determined at constant air velocity of 350 F.P.M.
2. Contaminant Feed Rate is .0185 grams per min. per sq. inch. Contaminant is standard A.F.I. Test Dust consisting of
   72% Fine Air Cleaner Test Dust (Road Dust)
   3% Cotton Linters Wiley Mill Ground (Lint)
   25% K-1 Carbon Black (Soot)

TEST RESULTS:
Efficiency — 71.1%
Dust Holding Capacity — .68 grams per sq. inch.

These and other Original Equipment Manufacturers now bring you the remarkable air-cleaning action of new FRAM permachem-treated Air Filters . . .

Air Filters kill 99+% of germs trapped...
itioning and forced air heating systems

Now . . . for the first time ever . . . you can specify filters for air conditioning and forced air heating systems that not only trap dust, dirt, pollen and other airborne pollution . . . but also *kill 99+% of germs trapped in the filter!*

Only new FRAM permachem-treated Air Filters offer you this remarkable germ-killing action. Here's why. These revolutionary new filters are treated with *permachem* — a hospital-proved germicidal chemical that lasts for the entire life of the filter. Result: germs trapped in the filter are destroyed . . . air is kept hospital clean!

That's one reason why leading Original Equipment Manufacturers select new FRAM permachem-treated Air Filters for their 1960 central systems. These manufacturers also find that new FRAM permachem-treated Air Filters offer:

1. LONGER LIFE — Scientifically-blended acetate fibers provide full-depth filtration . . . give 12 to 46% longer filter life, according to direct comparative tests!

2. BIGGER CAPACITY — New FRAM permachem-treated Air Filters trap bacteria, pollen, dirt, smoke, airborne pollution . . . hold up to 34% more dust in direct comparative tests!

3. DRY-FILTER DESIGN — These remarkable new filters do not use oil . . . cannot clog ductwork, stain walls and ceilings!

4. MAXIMUM FILTERING SURFACE — New FRAM permachem-treated Air Filters have metal backing on just *one* side . . . give most effective filtering surface of any filter!

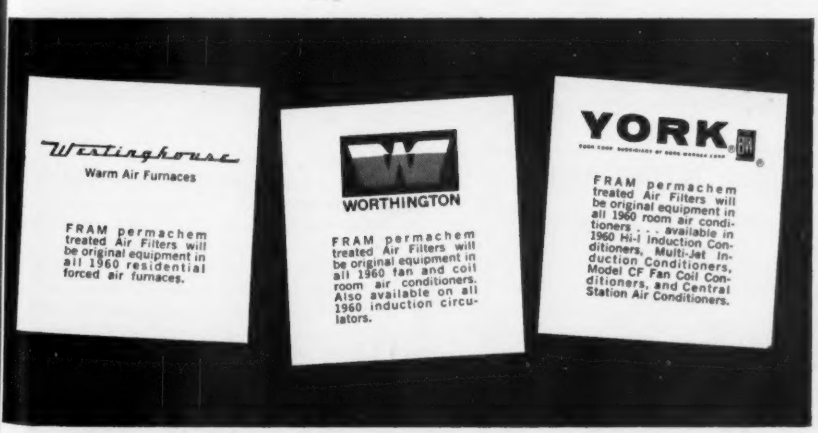
5. STRONGER CONSTRUCTION — These rugged new filters have unique single-unit, anchor-locked frames . . . media cannot settle, vibrate, blow or soak loose!

6. SOFT, SAFE MEDIA — New FRAM permachem-treated Air Filters have a media that's pleasant to handle . . . nonirritating . . . nonhazardous!

Wide choice of sizes. New FRAM permachem-treated Air Filters are available in sizes and types to fit *all* air conditioning and forced air heating systems that use standard velocity, disposable-type filters.

FRAM offers you specification help, too. FRAM Aire now has service representatives and distributors in all parts of the country to help you. Contact your local FRAM Aire distributor now, or write directly to FRAM Aire. Be sure you get your free copy of the technical manual on FRAM permachem-treated Air Filters.

Guaranteed by Good Housekeeping



FRAM *Aire Corporation* DIVISION OF FRAM CORPORATION, PROVIDENCE 16, R. I.

Now that you mention it—

REYNOLDS . . .

IN A STAGE OF CHAOS

To the Editor:

"How refrigerant properties affect impeller dimensions" in the October 1959 issue of the ASHRAE JOURNAL shows how refrigerants may be chosen to give optimum refrigerator performance and makes a useful addition to the information available on centrifugal compressors operating at high Mach Numbers.

It is of interest to see (Fig. 2) how closely the authors' compressors line up with Stepanoff's Chart of best efficiency point performance of pumps and blowers.

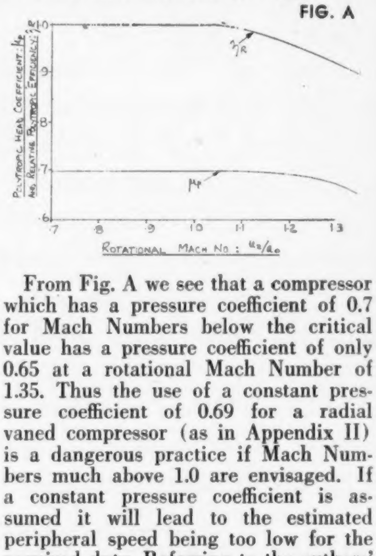
Should it perhaps be stressed for the benefit of those new to centrifugal compressor design that the existence of the charts shown in Figs. 2 and 3 is no guarantee that these results will be obtained? That the authors have obtained results of this order and at high Mach Numbers is the result of good design technique. A point to be borne in mind when using Fig. 2 is that for radial vaned compressors ($\beta 2 = 90°$), the best efficiency point is usually rather near to the surge point. It may be necessary to design the compressor so that its peak operating duty occurs at a flow coefficient higher than that of the best efficiency point, in order to allow for off peak duties and variation between the estimated volume flow and the actual service volume flow.

Are the experimental results given on Fig. 2 calculated assuming isentropic flow in the impeller or has the impeller tip flow coefficient been calculated from test results including static pressure and temperature readings at the impeller tip? While on the subject of the flow through the impeller it would be interesting to know whether the authors estimated the effect of the isentropic flow assumption upon diffuser and volute design by comparing calculated velocities at the impeller tip with impeller tip test results. Also does Fig. 7 refer to a meridional deceleration assuming isentropic flow in the impeller? Fig. 7 is presumably based upon a correlation of test results and will be a measure of how meridional deceleration causes a bad velocity distribution towards the impeller tip and hence interferes with diffuser performance.

Are the curves showing variation of polytropic efficiency with rotational Mach Number based upon tests carried out by the authors or are they taken from the literature? My experience is that rotational Mach Number does not affect compressor stage performance until it is increased above a critical Mach Number when the polytropic efficiency and the pressure coefficient both decrease. This is shown in accompanying Fig. A.

The numerical value of the Critical Rotational Mach Number varies from compressor to compressor depending upon inducer tip relative Mach Number, impeller vane angle and diffuser characteristics (but one would expect it to be somewhere between 0.8—1.1).

FIG. A



From Fig. A we see that a compressor which has a pressure coefficient of 0.7 for Mach Numbers below the critical value has a pressure coefficient of only 0.65 at a rotational Mach Number of 1.35. Thus the use of a constant pressure coefficient of 0.69 for a radial vaned compressor (as in Appendix II) is a dangerous practice if Mach Numbers much above 1.0 are envisaged. If a constant pressure coefficient is assumed it will lead to the estimated peripheral speed being too low for the required duty. Referring to the authors' test figures, it is seen, however, in Fig. 2 that the two radial vaned blowers (Experimental and N.A.C.A. TN.1313) have a pressure coefficient of about 0.72 for a Mach Number of 1.06 to 1.09. Thus for the compressors considered, a pressure coefficient of 0.69 is conservative for low Mach Numbers. However, for Mach Numbers in the region of 1.5, the pressure coefficient would have dropped appreciably.

It would be interesting to know what range of Reynolds Number is covered by the curves of Fig. 4 and what is the basis of the curves.

Reynolds Number had no effect upon the performance of the compressor of Fig. A over a range of inlet Reynolds Number of 4 x 10^6 to 5 x 10^6. Davis (A.S.M.E. Paper No. 56-A-122) and Kovach & Withee (N.A.C.A. RM. E52.H19—1952) found fairly large ranges where Reynolds Number has a negligible effect upon centrifugal compressor performance. The whole subject of Reynolds Number effects in centrifugal blowers appears to be in a stage of chaos. However, referring once more to Appendix II of the paper, if there is a Reynolds Number effect it will certainly reduce the pressure coefficient and hence require a higher peripheral speed than that calculated.

T. B. FERGUSON
Lecturer
in Mech. Engg.

Dept. of Mech. Engg.
University of Sheffield,
England.

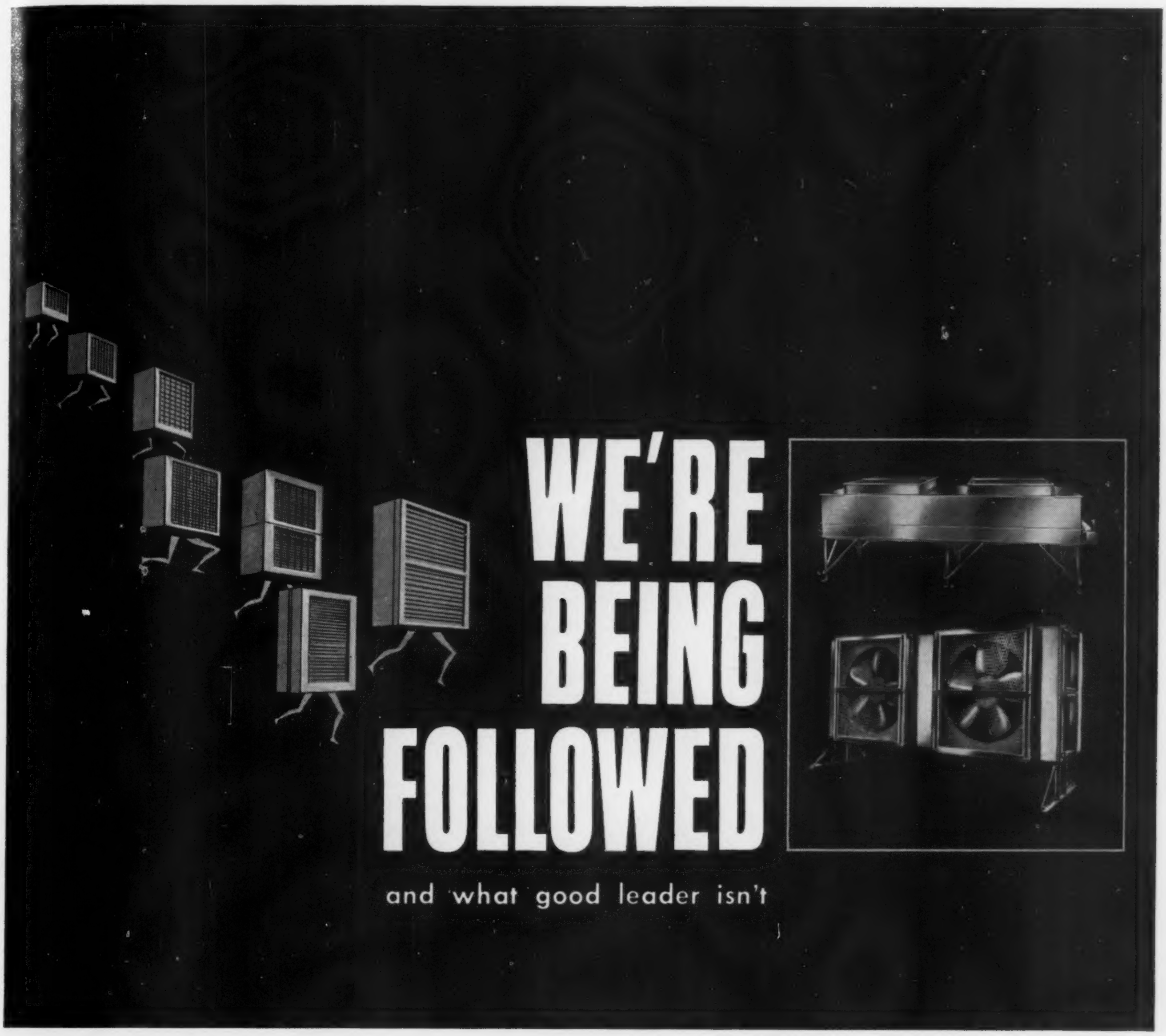
NATIONAL MEETINGS AHEAD

June 13-15 Annual
Vancouver, B.C.

1961

Feb. 13-16 Semiannual
Chicago, Ill.

June 26-28 Annual
Denver, Colo.


WE'RE BEING FOLLOWED
and what good leader isn't

New Westinghouse *Guardistor* motor stops motor failure caused by excess heat

At last, positive protection against motor overheating with this unique Westinghouse motor development. Smaller than an aspirin, the heart of the Guardistor* motor is a PTC† Thermistor embedded in the motor windings to sense temperature rise immediately.

With normal motor temperatures, the thermistor has low resistance which remains nearly constant up to a predetermined critical temperature. At this temperature, a 100 to 1 or more increase in resistance occurs for a small increase in temperature. The resistance stops current flow activating a control designed to "WARN" or "STOP" a motor failure.

The Guardistor motor and associated control integrates all heat-causing factors of load, ambient, and power supply right in the motor windings to give you complete protection against motor burn-out.

*Trade-Mark
†Positive Temperature Coefficient

J-22155-R

YOU CAN BE SURE...IF IT'S

Westinghouse

Watch Westinghouse Lucille Ball-Desi Arnaz Shows
CBS TV Alternate Fridays

Late news highlights

In greater demand Both industrial recruiting and overall demand for engineers increased in 1959, "Demand for Engineers – 1959," ninth annual report of the Engineering Manpower Commission of Engineers Joint Council discloses. However, numerical shortages were not widespread because of the large number of engineering graduates available for employment; 1959 was the largest class since 1951. Starting salaries are at an all-time high, averaging $510 monthly for B.S. graduates, $600 for M.S. graduates and $825 for Ph.D.'s, with aircraft, electrical equipment and electronics industries offering the highest salaries. Copies of this report are available from EMC, 29 West 39th Street, New York 18, N. Y.

duPont grants 143 universities and colleges are recipients of grants totaling more than $1,300,000 awarded in duPont's annual program of aid to education, to be used for fundamental research by universities, for strengthening teaching of science and related subjects, and for facilities for education or research in science and engineering. Largest part of the program is earmarked to help strengthen the education of scientists and engineers.

15th Exposition 15th International Heating & Air Conditioning Exposition will be held concurrently with the ASHRAE Semiannual Meeting in Chicago, Ill., February 13-16, 1961.

Research review Information relating to over 10,000 research projects now under way in 118 leading engineering colleges in this country is contained in "Engineering College Research Review 1959," the biennial review published by the Engineering College Research Council of the American Society for Engineering Education. Expenditures on these activities during the current year will total over $112,000,000, according to the figures. Copies of the Review are available from the Secretary, ASEE, University of Illinois, Urbana, Ill., $2.

One year old Beginning the second year of operation of its Unitary Air-Conditioner Certification Program, the Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington 6, D.C., issued the first 1960 Directory of Certified Unitary Air-Conditioners, which lists some 1995 models of about fifty participating manufacturers.

Crane to acquire U.S.-National Acquisition of the operating assets of National-U.S. Radiator Corporation by the Crane Company has been approved by the Boards of Directors of both companies. Following approval by National-U.S. stockholders in January, the plant equipment and inventory will be transferred to Crane on February 1 for $15 million in cash.

Manual on duct construction "Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems" is now available from the Sheet Metal and Air Conditioning Contractors National Association, Inc. SMACNA non-members may obtain a copy for $5 from the Association at 107 Center Street, Elgin, Ill.

New "Engineer" In a greatly increased publication program by Engineers Joint Council, an expanded version of the "Engineer" – reporting upon activities of the Council and other society organizations, as well as national affairs news of interest to the profession – will be distributed automatically to the entire membership of its societies.

Office survey "Physiological Factors Governing Office Environment," a survey by the National Office Management Association, is a compilation of 1974 companies on the changes that factors such as air conditioning, lighting, sound control, music and furniture have produced in today's office. This 14-page report is available from the World Headquarters of the National Office Management Association, 1931 Old York Road, Willow Grove, Pa.; price is $2.

Air cleaning program Included within the 1960 Spring Conferences of the Building Research Institute to be held April 5-7 in New York City will be a comprehensive program on air cleaning comprising papers and panel discussions on filtration, odor control and smog removal as well as reports on the application of research to the environment of space capsules, under the supervision of John E. Haines, a Past President of ASHRAE.

To acquaint students Western Air Conditioning Industries Association has presented $1000 to California State Polytechnic College Air Conditioning Dept to be used to acquaint high school and junior college students with the broad opportunities available in the air conditioning industry.

Merger Directors of Aeronca Manufacturing Corp. of Middletown, Ohio, and Buensod-Stacey, Inc. of New York, N.Y., have approved an agreement to merge the two companies. Shareholders of both firms are expected to meet in February to consider the merger; if approved, Buensod-Stacey would be operated as a self-contained division of Aeronca.

Oil heat gains There was a 12% gain in total sales of domestic burners in 1959 over 1958, the greatest increase for oil heat in three years. Furthermore, according to Robert Gray, president of the National Fueloil Council, the outlook for 1960 continues to be promising.

Cryogenic conference Co-sponsored by the University of Colorado and the National Bureau of Standards, the 1960 Cryogenic Engineering Conference will take place in Boulder, Colo., August 23-25. Papers for presentation at this sixth meeting in the series dealing with technical aspects of cryogenic engineering in the field below 150 K and covering recent fundamental work are now being solicited; deadline for abstracts and preliminary manuscripts is May 15.

Heat Transfer Symposium Among topics to be covered at various sessions of the Heat Transfer Symposium, sponsored annually by the Dept of Mechanical Engineering of the University of Florida, to be held March 7 and 8 at the University in Gainesville, Fla., will be Basic Principles, Temperature and Its Measurement, Heat Exchangers, Graphical Methods and the Hydraulic Analog.

Automatic refrigeration Available in an English translation, *Automatic Refrigeration* by Professor S. A. Anderson of the University of Denmark, has a two-fold purpose – first, as a survey of principles and techniques of refrigeration, and second, as a guide to engineers listing calculation sheets, tables and diagrams. This 649-page volume may be obtained through Refrigeration Press Ltd., Maclaren House, 131 Great Suffolk Street, London, S.E. 1, England. Price is $13.50 in U.S.A. and Canada.

Package design "What Criteria Should Be Considered in Package Design to Prevent Container Fatigue and Failure in Refrigerated Warehouses?" will be the topic of a symposium sponsored by the Scientific Advisory Council of the Refrigeration Research Foundation to be held in Chicago, Ill., March 18 and 19. Council includes ASHRAE members Laurence V. Burton, Carl F. Kayan, W. T. Pentzer, Edward Simons, Donald K. Tressler and J. G. Woodroof.

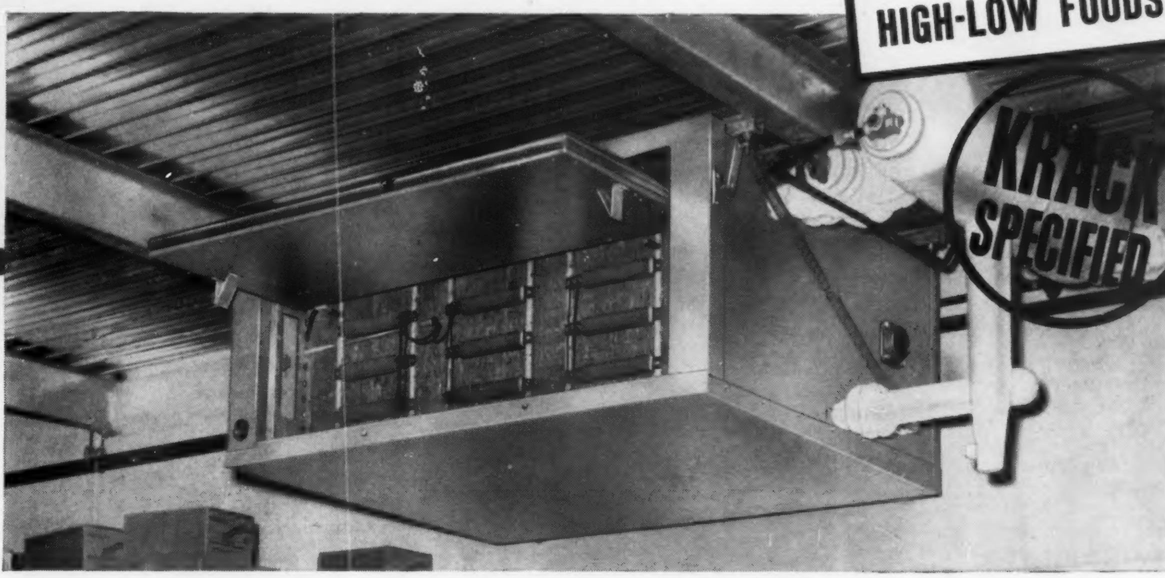
Funds for research December 1959 issue of "Reviews of Data on Research & Development" published by the National Science Foundation reports on Funds for Research and Development in the United States, 1953-59. Copies of the 8-page pamphlet (NSF 59-65) may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 10 cents.

ASHRAE pamphlet Prepared under the auspices of the ASHRAE Education Committee, the pamphlet "Opportunities in Engineering" is designed for high school students, outlining the opportunities present in the fields of heating, refrigerating and air conditioning. Descriptions of underlying principles and applications of these fields are provided in the booklet, as well as information relating to preparation for entrance into an institute or college.

KRACK AUTOMATIC DEFROST COOLERS GIVE HIGH-LOW FOODS, CHICAGO

33% more storage

IN SAME SPACE



L. C. Kohlman, Inc., Contractors designed and installed this system

Three rooms to be cooled—each room 105′ x 22′ x 13′ high

For low temperature frozen food room—three Krack No. 36-ED Automatic Electric Defrost Units. 4,760 BTU/hr/1° TD capacity for each unit. Refrigerant: Flooded Ammonia. Type: ceiling.

For two cooler rooms—two Krack No. 5 floor type Industrial Product Coolers. 17,200 BTU/hr/1° TD and 21,300 CFM capacity for each unit.

HIGH-LOW FOODS GOT 2 BENEFITS...

when they installed Krack Electric Defrost Coolers. First, they gained ⅓ more usable storage space by removing hundreds of feet of piping made obsolete by new Krack Coolers. Second, they cut maintenance and labor costs because shutdowns for manual defrosting were eliminated.

Five Krack Coolers were used. Three low temperature electric defrost ceiling coolers maintain −10° F. in the frozen food room; two floor units hold temperature at 36° F. in two dry storage rooms. Krack equipment was chosen by High-Low Foods' management because of dependable past performance. They have been a satisfied user of Krack equipment for 28 years.

Find out how KRACK can solve your refrigeration and installation problems!

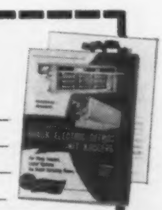
KRACK ENGINEERED REFRIGERATION APPLIANCES, INC.

Manufacturers of Freon or Ammonia, Recirculated, Flooded or Direct Expansion Heat Transfer Equipment

MAIL COUPON FOR FREE BULLETINS ED-1055 BEF-360

REFRIGERATION APPLIANCES, INC.
917 W. Lake St., Chicago 7, Ill.

Name__________
Firm__________
Street__________
City______ Zone____ State______

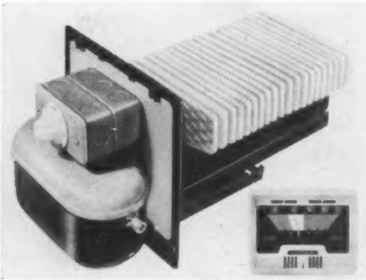


0130

PARTS and PRODUCTS

HUMIDIFIER

Utilized in this new unit is a Vapoglas plate humidifier with an added electric element designed to provide controlled humidification during the entire heating season. Twenty evapo-



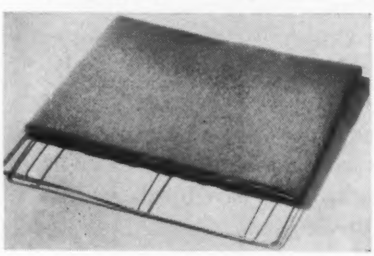
rating plates in a corrosion resistant evaporating pan are used, with a 625 watt electrical element, incased in Cerrafelt, placed under the pan to aid in elimination of hard water deposits on the heating element.

As an added feature, a hygrometer is furnished with Model 900, to indicate the percentage of relative humidity in the air and aid adjustment of the humidifier.

Skuttle Manufacturing Company, Milford, Mich.

FURNACE FILTER

Featured in this washable furnace filter, made of Scottfoam (polyurethane foam), is a zipper opening to permit easy removal of the retaining frame. When dirty, the filter may be cleaned by hand or machine with common household soaps, solvents or detergents, wrung dry and replaced in the



frame. It is treated with a germicide additive and is non-allergenic and non-toxic.

Auto-Flo Corporation, Detroit, Mich.

PLASTICS FOAM

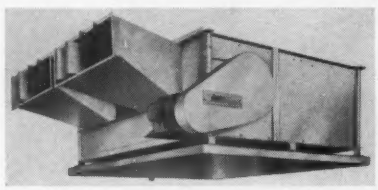
Low in density, this polyvinyl chloride foam is deep cushioning and, according to the manufacturer, is the only vinyl foam being produced by a continuous chemically blown process. This method is cited as giving a sheet of consistently uniform quality.

Continuous lengths, up to 48 in. wide, are available, and thicknesses as small as ⅛ in. are produced. Not subject to aging deterioration, the foam offers resistance to acids, alkalies, grease, oils, high humidity, sunlight, water and air.

Highside Foam Products, Inc., 10 Colfax Ave., Clifton, N. J.

SPACE COOLERS

Arranged for ceiling mounting, this line of evaporators is provided with a fin coil, in a variety of fin spacings and number of rows, with which any desired balance of air volume and coil capacity may be achieved. Casings



can be furnished hot dip galvanized after fabrication.

Coils can be arranged for thermal valve, flooded operation with surge drum and float, liquid recirculation and for ammonia, brine or other refrigerant. Air volumes range from 2500 to 28,000 cfm and capacity from 5 to 30 ton.

Imeco, Inc., 3033 W. Belmont Ave., Chicago 18, Ill.

RECORDING INSTRUMENTS

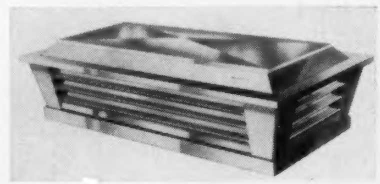
Temperature, pressure and humidity recording instruments featuring ease of reading and dependable accuracy throughout the entire working range comprise this new line. Contained in completely redesigned aluminum cases, the instruments are available in 8-in. chart size with one to three pen systems or 10 or 12-in. chart sizes with one to four pen systems, and in hand wound or electric chart drives for 12 hr, 24 hr, 7 day and 31 day revolution.

Temperature recorders are mercury, liquid, gas or vapor actuated, supplied in all standard ranges from –100 to 1000 F. Pressure recorders contain specially heat treated spiral wound bronze, beryllium copper, alloy or stainless steel bourdon springs with all stainless steel movement and micrometer adjustment. All standard ranges from 30 in. vacuum to 10,000 psi are available. Humidity recorders are of two types: direct reading hygrograph with hair element and the hygrometer with wet and dry bulb; standard ranges are from zero to 100 F and zero to 100% relative humidity.

Weksler Instruments Corporation, 195 E. Merrick Rd., Freeport, Long Island, New York.

VENTILATORS

Now available in a full range of sizes from 10 through 60-in., these units

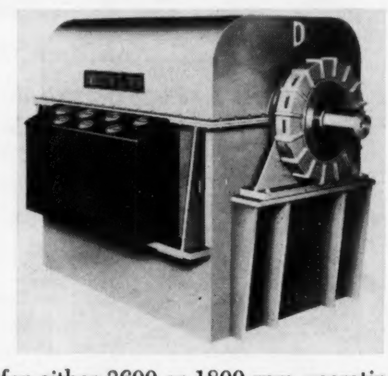


were created specifically to meet requests for ventilators with a lower silhouette. Included are both gravity and power units.

G. C. Breidert Company, P. O. Box 1190, San Fernando, Calif.

FLUID DRIVES

Developed for use with "on-the-shaft" boiler feed pump drive arrangements, these Gyrol units, designated Type VS Class 7, provide a stepless, adjustable speed control and are available for use with any size boiler feed pump. Standard units are available



for either 3600 or 1800 rpm operating input speed.

Fluid drive shaft height is matched to the centerline height of the main turbine shaft to simplify floor mounting. The Class 7 unit is designed for below-floor installation of auxiliary cooling equipment and related piping.

American Standard, Industrial Div, Detroit 32, Mich.

ASBESTOS SHEET PACKING

Available in eight basic grades in standard size sheets including commercial, intermediate, Navy, premium, neoprene, premium neoprene and blue asbestos, this packing is de-

SPECIFY • INSTALL

ALCO EVAPORATOR PRESSURE REGULATORS

Your protection from freeze-up

- SODA FOUNTAINS
- BEVERAGE COOLERS
- PRODUCE CASES AND PRODUCTS
- PLATING BATHS
- WATER CHILLERS
  —from the smallest to the largest

Eliminates tube bursting

TYPES 15, 16, 18
Refrigerant 12
Refrigerant 22
Ammonia

TYPE 760
Refrigerant 12

TYPE 435
Refrigerant 12

ALCO'S EVAPORATOR PRESSURE REGULATORS are designed, engineered and manufactured by ALCO, under ALCO'S HIGH QUALITY CONTROL SYSTEM—to efficiently maintain *evaporator pressure* in either a single or multipal system—*regardless of load changes.*

ALCO EPR VALVES are available from ½" to 6" port sizes and all connections up to and including 6⅛" O.D.F.—FOR ALL REFRIGERANTS.

Call your ALCO Wholesaler, Write for Specifications Bulletin #183-57

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8221

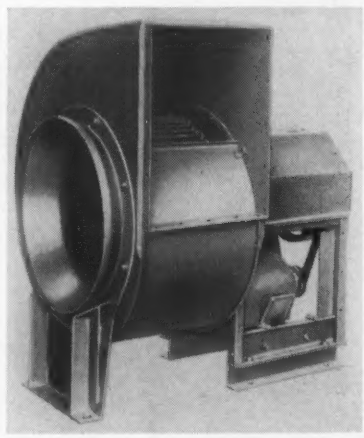
ALCO VALVE CO.
855 KINGSLAND AVE. • ST. LOUIS 5, MO.

The one complete line of refrigerant controls: Thermostatic Expansion Valves • Refrigerant Distributors Solenoid Valves • Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves

signed primarily as a gasketing material for a variety of industrial uses. Average tensile strength of the material ranges from 3000 to 5000 psi, dependent on the grade, and it is able to withstand temperatures up to 700 F.
Union Asbestos & Rubber Company, Fibrous Products Div, 1111 W. Perry St., Bloomington, Ill.

V-BELT FANS

Furnished complete with motor and drive integrated in one assembly, these ready-to-run units are suited to supply or exhaust applications, indoors or outdoors, for volumes to 25,000 cfm,

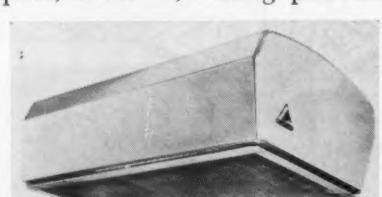


static pressures through 2½-in. and temperatures to 300 F. Type LS units have low speed, forward curve multiblade wheels and are offered in 13 sizes; Type MS have medium speed backward inclined blade wheels and are available in 12 sizes. Shown is a unit as constructed in the intermediate sizes.

Features of these fan sets are: complete accessibility to motor, drive and bearings; easy changing of discharge direction; entire drive within frame of the unit; each wheel balanced both statically and dynamically; and each unit given a running inspection test at specified operating speed.
Clarage Fan Company, Kalamazoo, Mich.

OUTDOOR HEATERS

Suggested areas of application for these infra-red heaters include marquees, sidewalks, loading platforms,



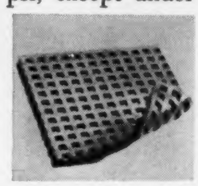
patios, swimming pools, drive-in restaurants, station platforms, grandstands and airport boarding areas, where they provide a simple way of preventing snow accumulation and warming exposed areas where people congregate.

Fired by natural, L.P., mixed or manufactured gas, the model JM-524 heater shown is rated at 48,000 Btu/hr and utilizes a directional and protective aluminum honeycomb screen on its reflector to produce a concentration of heat.
Perfection Industries Div, Hupp Corporation, 1135 Ivanhoe Rd., Cleveland 10, Ohio.

MOUNTING PADS

Low cost machine mountings are cited as being made possible through use of Fabcel Pads, which eliminate the need for bolts, lag screws or cement under most machines. Suction cells in the pads anchor equipment to the floor, at the same time controlling vibration, absorbing shock, reducing noise and improving machine performance.

For best results, these pads should carry a load of 50 psi, except under impact machinery such as punch presses, where the loading should be reduced to approximately 25 psi. Manufactured in 18-in. squares, the pads are easily cut to any shape desired.



Fabreeka Products Company, Inc., 1190 Adams St., Boston 24, Mass.

PILOT LIGHTS

Included in this line of sub-miniatures is a new series of water-tight units designed to mount from the front of the panel in a single 15/32-in. clearance hole. Fully insulated, Series 101-8430W lights require no special insulating washers; socket, lamp and all connections are insulated from the mounting bushing by phenolic material. Two terminals are provided for the electrical connections.

"All-angle visibility" is provided by a stovepipe-shaped cap of high heat plastic, available in transparent or translucent finish. Terminals are perforated for wire.
Dialight Corporation, 60 Stewart Ave., Brooklyn 37, N. Y.

AIR HANDLERS

For centralized conditioning service, these units are offered in 16 models, with many variations. Capacities range from 880 to 47,500 cfm and coil face velocities from 400 to 700 fpm. These air quantities are cited

as being obtainable even under static loads up to 2-in. w.g.

Air handlers in this line may be used with direct expansion coils (capacities range from 3 to 120 nominal ton under standard conditions), chilled water or hot water coils, or steam coils. Face areas range from 2 to 68 sq ft.

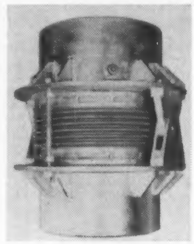
Discharge direction may be horizontal or vertical; either high or low velocity filters may be selected, and the choice includes cleanable or throw-away designs. As an optional feature, vibration isolators for ceiling hung units may be specified. Insulation is fire-proof, vermin-proof and water-proof.

Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

EXPANSION JOINTS

Permitting a piping system to be entirely self-supporting, these hinged expansion joints eliminate the need for additional supports and reduce pipe line bending stresses. Shear loads, piping weight, wind and other dead loads can be absorbed by the joints without extensive anchoring.

Designed to take rotation in one plane only, the standard model is used in combinations of two or three. Slotted hinges are available for special applications where axial movement must be permitted, but these units do not absorb axial pressure thrust.



Three basic types are available to meet requirements of movement, pressure and temperature conditions, with special models for greater degrees of rotation.

Zallea Brothers, 815 Locust St., Wilmington 99, Del.

1960 CONDITIONERS

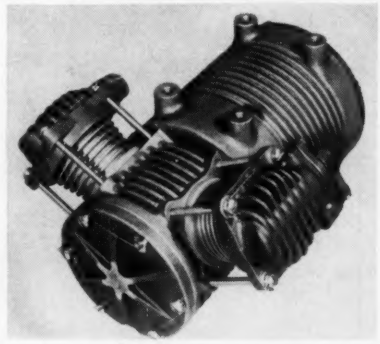
Extension of the "Kool-Mount" feature, a design providing for automatic installation of an air conditioner in a window without use of any tools, to a broader range of models highlights this manufacturer's 1960 line of air conditioners. Now included are a high capacity series, available in one, one and one-half and two hp models with cooling capacities of 7000 to 15,000 Btus, and two reverse cycle models with heating capacities of 8500 and 10,000 Btus.

All models in the entire series are identical in outward appearances and are equipped with a permanent slide-out filter that can be removed for cleaning without disassembling the front, a two-speed fan, fresh air intake, push-button control panel for all operations and automatic thermostat. There are no side louvers and blower wheels are used for both condenser and evaporator to maintain quieter operation.

Emerson Radio & Phonograph Corporation, Jersey City 2, N. J.

MOTOR COMPRESSORS

With life expectancies ranging up to 5000 hr, the hermetically-sealed com-



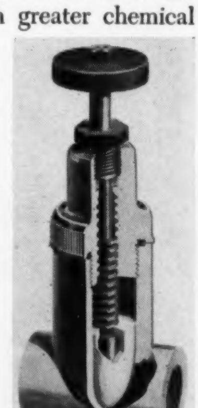
pressors in this line, one unit of which is shown, may be operated at high ambient temperatures. For use in electronic cooling systems in aircraft, missile and ground support systems, the units feature light weight, small size and the ability to operate in any position due to an oil-mist lubrication system.

Three-phase, 400 cps motors in either single or two-stage design power the compressors, which range from 1/6 through 6½ hp in size. Refrigerants 11, 12, 22 and 114 may be used depending on the application.

Great Lakes Manufacturing Corporation, 4223 Monticello Blvd., Cleveland, Ohio.

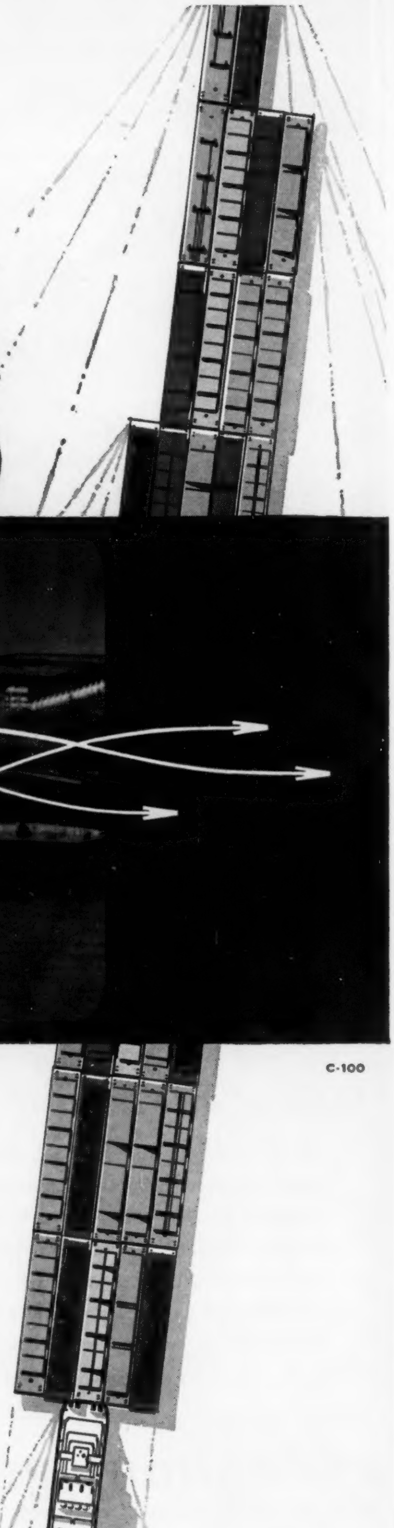
PLASTICS GATE VALVE

To meet process industries' need for plastics valves with greater chemical resistance to organic and inorganic agents at elevated temperatures, this line has been expanded to include valves made of Penton.

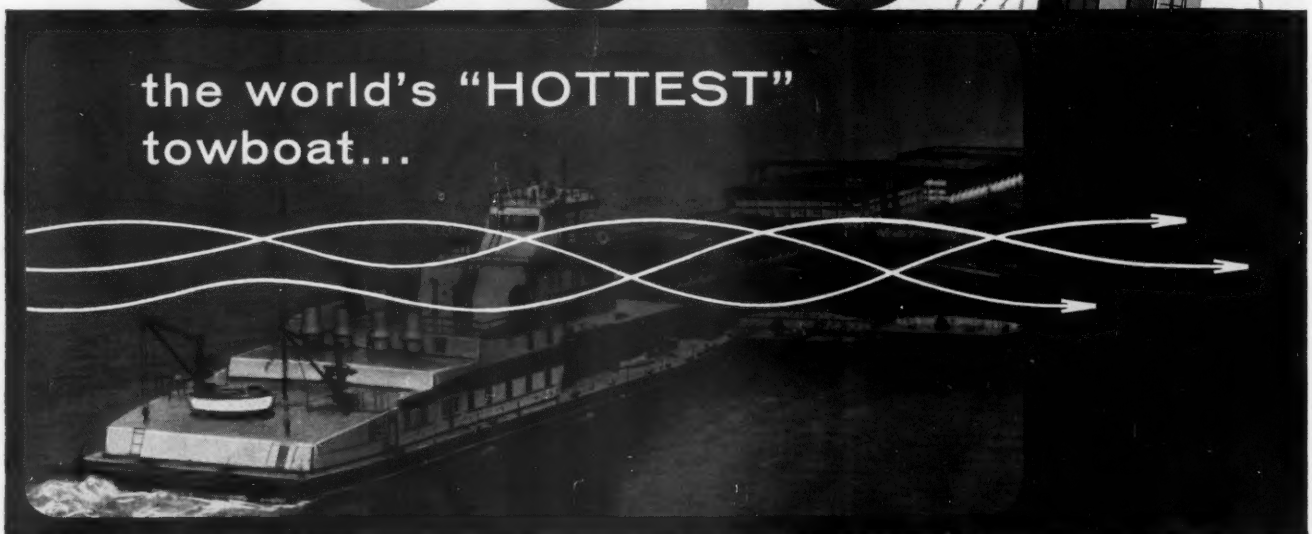


These throttlable valves, which do not lose tensile strength or hardness and which are not subject to elongation at elevated temperatures (100 to 125 C), are generally resistant to all inorganic acids except fuming nitric

See our exhibit Booth 320, Southwest Heating & Air Conditioning Exposition Dallas, Texas, February 1 Thru February 4, 1960



Curtis COOLS



the world's "HOTTEST" towboat...

Huge 180 foot Federal Barge Lines towboat, the United States, has 50% greater horsepower than the largest towboat on the rivers. It can push 40 barges, totaling 1/3 mile, or 300 ft. longer than the "Queen Elizabeth".

C-100

Space saving design versatility? Easy installation? Operating dependability? Comparative cost? All these factors were considered by St. Louis Shipbuilding and Steel Company in the selection of air conditioning equipment for the world's most powerful towboat. The shipbuilders' and their design engineers' careful choice? A Curtis 20-ton packaged liquid chiller system. This equipment will cool the crew's quarters, galley, mess room, officers' and guest quarters—all with individual room or area temperature control.

The Curtis complete line, and reputation for dependability in installations of all types, work to the benefit of engineers and mechanical contractors. Factory run-in of all units cuts call backs far below average. You can safely promise dependable performance always up to, and frequently surpassing, rated capacity. You eliminate your problems when you specify Curtis, because you're working with an outstanding manufacturer of air conditioning equipment.

THE COMPLETE LINE OF LIQUID CHILLERS • PACKAGED AIR CONDITIONERS • CONDENSING UNITS

Curtis

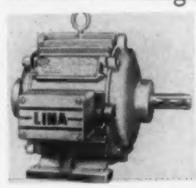
ESTABLISHED IN 1854

MANUFACTURING COMPANY • REFRIGERATION DIVISION • *St. Louis 33, Missouri*

and sulfuric. Sizes from ½ to 2 in. are available with socket weld, flanged or screwed ends.
Vanton Pump & Equipment Corporation, Hillside, N. J.

FAN-DUTY MOTORS

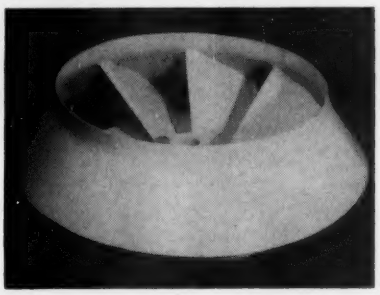
Furnished in speeds of 1800, 1200 and 900 rpm, these motors feature, in addition to totally-enclosed housings, deep external cooling fins with a reduced transverse section to give low wind resistance. Duty rating is continuous and temperature rise is rated at 55 C. Type EFD motors are available for three- or two-phase operation in all standard frequencies and commercial voltages below 600.



Lima Electric Motor Company, Inc., Lima, Ohio.

CENTRIFUGAL FAN

Improvements in wheel and vane design are cited as having increased the



static efficiency of these tubular centrifugal fans by as much as 14%. Performance tests indicate that new static efficiencies range from 79 to 85%, depending on fan size.

Changes responsible for these gains include improved blading design to minimize turbulence and energy loss, a more streamlined back plate and modification of the pressure vanes to match the new rotor design.
Dryer Electric Corporation, 164-166 Wallabout St., Brooklyn 6, N. Y.

TWO HEATERS

Broadening this line of infra-red radiant heating units are two new models, of 450 and 1500 watt capacity. Each is designed for both domestic and industrial use and can be installed on either wall or ceiling. Although the wattage is low, the radiant heat output is more direct and faster than convection or forced air heaters. All parts are moisture resistant and will not be cracked or otherwise marred by water.

Model number 30902 (450 watt) will heat a 30-sq ft area while model 30903 (1500 watt) heats 90-sq ft. Focused and reflected by chrome-plated reflectors, the heat maintains its energy in the air through which it travels and cannot be diverted by cold air currents.
Engelhard Industries, Inc., Hanovia Lamp Div, 100 Chestnut St., Newark, New Jersey.

1960 LINE

Heading the list of products in this line is an absorption cold generator, available in nine sizes from 100 to 350 ton. Completely hermetic, it has single-shell construction and completely automatic operation. The unit is factory assembled and wired to provide installation flexibility.

Also available is a reciprocating cold generator with a hermetic model of the manufacturer's compressor. Units in 11 sizes range from 10 to 100 ton, with the 10-ton units using Refrigerant 12 and all others Refrigerant 22. Pneumatic or electric controls are available for all models and compressor-chiller units are supplied with either remote evaporative or air-cooled condensers.

Now available for air conditioning, as well as heating and ventilating, is a unit ventilator; refrigeration may be included when the unit is installed or

added later. Units can be equipped so future cooling requires only the addition of a source of chilled water.

To meet the more rigorous demands of Refrigerant 22, a hermetic compressor has been introduced, with single-housing construction minimizing alignment problems. Capacities from 10 to 100 ton are available.

Complete new lines of heating and cooling coils, compact and designed to minimize air by-pass and moisture carry-over on dehumidifying coils, have been added. A non-freeze type coil with one-in. tubes provides optimum temperature distribution and is completely drainable and cleanable.

More sizes and combinations of Central Station Air Conditioners, a line of industrial fans in three basic wheel types, a compact heat pump in sizes from 3 to 15 ton, and a gas-fired unit heater available in propeller, blower and duct styles with a range of 25,000 to 250,000 Btu round out the 1960 line of equipment.

Trane Company, La Crosse, Wisc.

MOISTURE LIQUID INDICATOR

Adaptable for use on original equipment and existing installations using Refrigerants 12 and 22, this unit utilizes a moisture sensitive element that changes color in relation to the amount or degree of moisture present. In addition, the words "Wet" and "Dry" appear in the viewing window to further indicate the moisture content of the refrigerant.

Henry Valve Company, 3215 North Ave., Melrose Park, Ill.

AIR PURIFIER

For installation with new central air conditioning systems in homes and smaller commercial establishments, or as an addition to existing systems, this automatic air purifier provides odor removal, winter humidification and air cleansing.

Use of a filtering element consisting of many layers of aluminum mesh screen, which is bathed every 20 sec by a wave of liquid passing from top to bottom, eliminates the necessity of cleaning the filter. The fluid used in the cleansing process, designated Carrex, contains a mixture of glycerine-like substances which picks up odors;

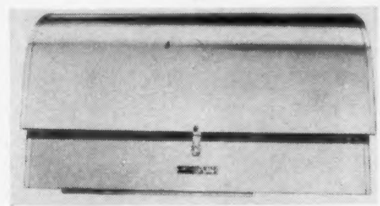
it is non-flammable, non-toxic, non-irritating and has no odor of its own. After absorbing odors passing through the filtering element, the fluid is heated and air is bubbled into it to carry the odor vapors through an outside vent. Humidity control is effected by regulating the proportion of water in the liquid mixture passing over the filter element.

Shown in the cut is the unit with panels removed to reveal the slanting filter element. At right is the regenerator where the solution is purged of odors.

Carrier Corporation, Syracuse 1, N.Y.

ROOF VENTILATOR

Constructed of heavy gauge galvanized steel with hinged motor hood, this low silhouette power ventilator has motor, belt and pillow block bear-



ings out of the air stream. Single-phase motors through one hp have built-in auto-reset thermal overload protector and floating vibration isolators are provided for quiet operation. Units are available in a range of sizes from 10¾ to 48½-in. wheel diam.

Carnes Corporation, Verona, Wisc.

SELF-CURING SEALANT

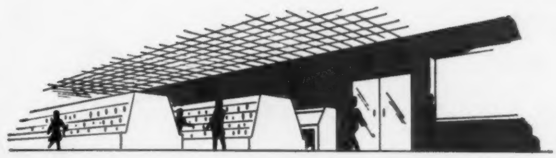
Developed originally as an all-purpose sealant for the building industry, this mastic, based on duPont's Hypalon synthetic rubber (chlorosulphonated polyethylene), was formerly available only in the form of extrusions and sheet. Now ready-to-use from the pail, with application by putty knife, the compound may be used to seal wooden tanks, trays or sinks; piping, drip-pans and ductwork; or wherever metals and other materials are joined to masonry.

Its properties suggest a wide range of applications, especially in glazing or sealing where prolonged exposure to sunlight, water, ozone, strong chemicals, heat, abrasion and movement are factors. Compounded in any desired hue, it can be applied to bare or coated surfaces, needing no separate primer to effect a lasting seal, and cures to a true rubber.

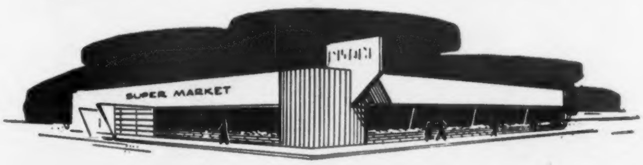
Rubber-like qualities are retained over a temperature range of −40 to 250 F.

Grayguard, Inc., P. O. Box 1644, Wilmington 99, Del.

The McQuay "AL" AIRCON air cooled condenser provides the ultimate in flexibility by combining refrigerant condensing with heating and ventilating. You can utilize condenser heat for heating, and this AIRCON may also be used for exhaust ventilation, saving both time and money in installation, maintenance and operating costs.



INSTALL IT INDOORS



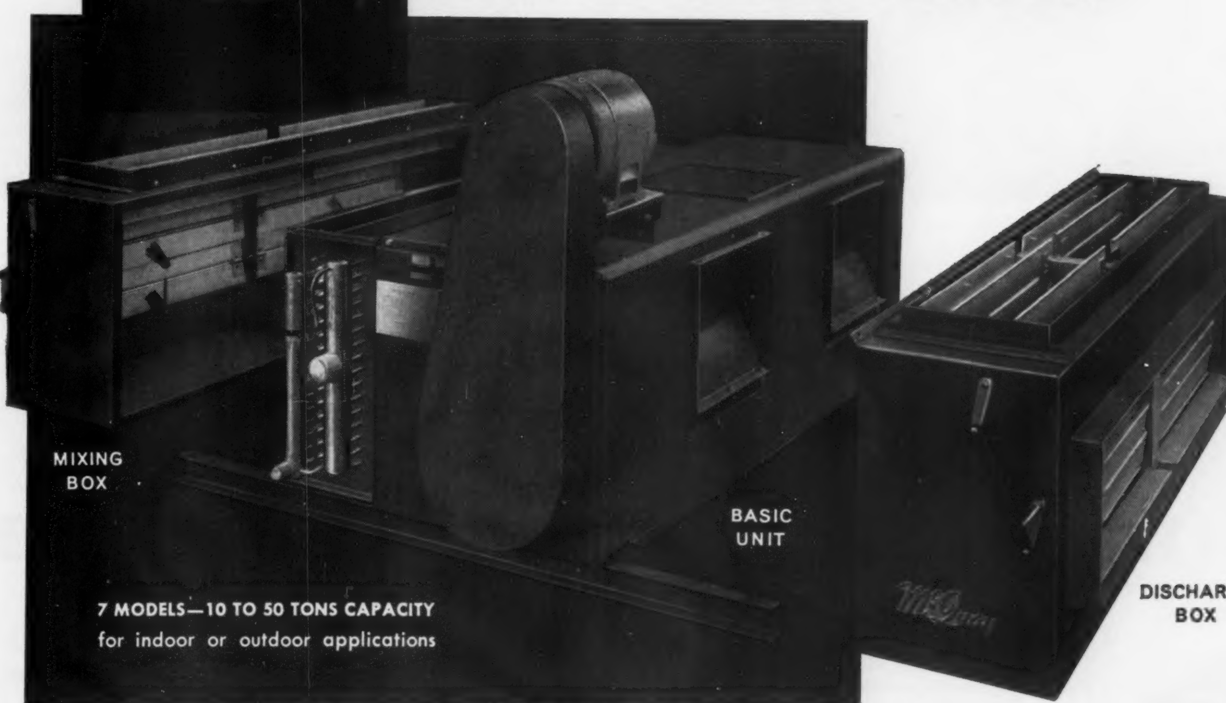
INSTALL IT OUTDOORS

"AL" AIRCON is compactly designed, and because of a very low silhouette, will not detract from the appearance of a building when roof mounted . . . the largest model is less than 4½ feet high, unnoticeable from the street.

"AL" AIRCON condensers are available in 8 different fan discharge arrangements and in 16 different unit arrangements . . . all standard. Each condenser coil is factory circuited in single or multiple sections to meet specific requirements of either air conditioning or refrigeration applications. Contact your nearest McQuay representative, or write McQuay, Inc., 1606 Broadway Street N. E., Minneapolis 13, Minnesota.

utilize condenser heat with this low silhouette blower type

AIR COOLED AIRCON



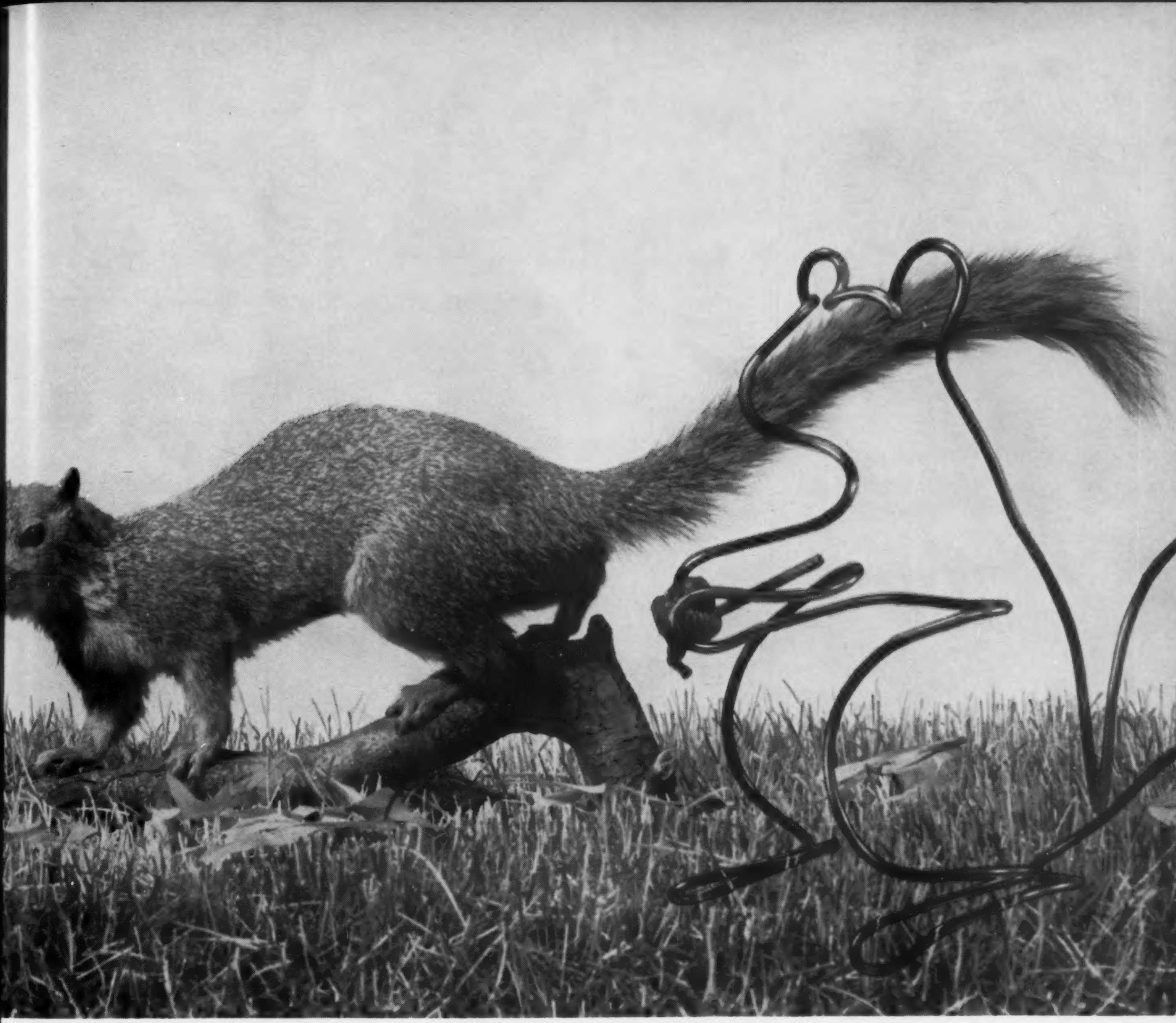
7 MODELS—10 TO 50 TONS CAPACITY
for indoor or outdoor applications

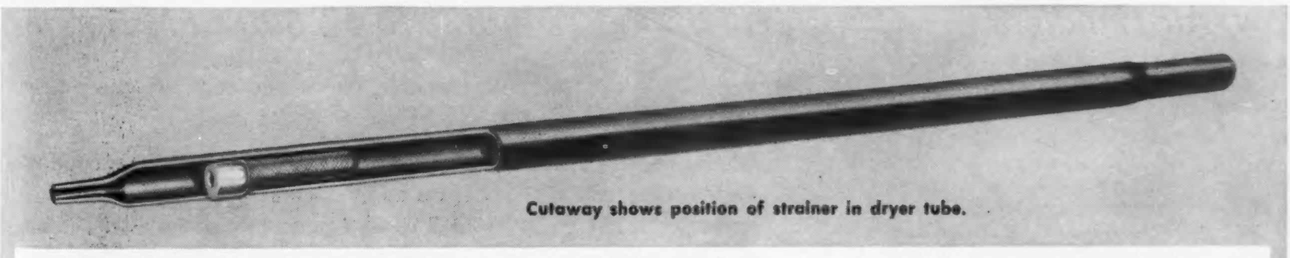
McQuay Means Quality

McQuay INC.

AIR CONDITIONING · HEATING · REFRIGERATION

MAKE THE SEASONS COME TO YOU





Cutaway shows position of strainer in dryer tube.

Something new for the air conditioning boys... and coils!

Now, Air Handlers from Halstead & Mitchell in 880 to 47,500 CFM Range

AH Series Air Handling Units

Halstead & Mitchell

Before you buy any Air Handler, check and compare these new H&M units, feature for feature and price for price.

See how easily H&M Air Handlers accommodate matching cooling and heating coils, with space for up to 12 rows of coil depth overall! If you like, H&M coils (from 2 to 68 square feet of face area) can be factory-installed, leaving protruding connections on either side for easy hook-up. Halstead & Mitchell makes the coils you need to match: direct expansion, chilled water, hot water, standard or non-freeze steam. Filter sections are also available.

Performance? H&M Air Handlers deliver air against static loads up to 2-inches water gauge, and do it quietly.

Construction? They're the sturdiest units in the field. Forward curved centrifugal blowers are enclosed in a heavy gauge cabinet featuring formed steel corner posts and flush mounted panels.

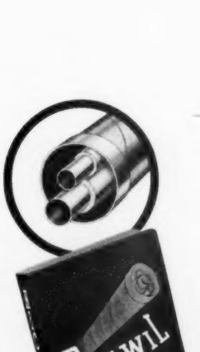
Price? Just ask your H&M distributor. You'll be pleased. He has all the engineering information, too. Or, you can write for Bulletin AHU-100, Halstead & Mitchell, Bessemer Building, Pittsburgh, Pa.

Air Handlers • Finned Coils • Air-Cooled Condensers • Cooling Towers • Water-Cooled Condensers

1910
1911
1912
1913
1914
1915
1916

RIC-WIL 50th Anniversary

1954
1955
1956
1957
1958
1959
1960



The year 1960 marks fifty years of service by Ric-wiL. Ric-wiL prefabricated and insulated distribution piping systems have been installed worldwide . . . truly, "The sun never sets on Ric-wiL installations". The quality of Ric-wiL prefabricated systems is proven by *many* millions of linear feet of piping . . . installed in every facet of industry, municipalities, colleges and universities and government projects throughout the world. Our aim for the next 50 years . . . continued leadership in underground and overhead prefabricated, insulated piping systems . . .

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

CENTRAL OFFICE: RIC-WIL INCORPORATED, BARBERTON, OHIO
WESTERN STATES: WESTERN RIC-WIL COMPANY, NEWARK, CALIF.
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

JOURNAL
FEBRUARY 1960

It takes a dual cooling system for

Refrigerating a homogeneous reactor

ROY C. ROBERTSON

A low-temperature refrigeration system is used in the Homogeneous Reactor Experiment (HRE-2) to chill cold traps in the off-gas streams and to chill freezers on the process lines to assure positive cutoff of flow. The high radiation level in the reactor cell presented special design problems, including selection of a secondary refrigerant. Design and development of the line freezer units had several unusual aspects.

The enriched uranium fuel used in the Homogeneous Reactor Experiment No. 2 (HRE-2, or HRT) is in the form of a uranyl sulfate solution. This liquid is circulated through a core tank of critical size, where it becomes heated to about 570 F, and then passes through a heat exchanger, where steam is generated. The heavy water in the blanket around the core is circulated in a similar manner.

A low temperature refrigeration system is an important auxiliary to the reactor system, both for normal operation and for maintenance purposes.

Cold traps are required in the vent lines from both the core and blanket systems to recover the heavy water in the off-gas and to prevent this moisture from reducing the effectiveness of the charcoal adsorber beds used to retain fission product gases. These cold traps are operated at –10 to –20 F. Freezer units are used to form ice plugs in process lines to assure positive shutoff of flow. Some of these lines are frozen during normal reactor operation to augment valves prone to leak, or used in lieu of valves to make special transfer operations. Line freezers are particularly useful for underwater maintenance purposes during reactor shutdowns, the ice plugs formed in the pipes adjacent to flanges serving the double purpose of preventing escape of activity into the shielding water and also preventing entry of this light water into the reactor system.

PRIMARY REFRIGERATION SYSTEM

The secondary refrigerant is chilled in a shell-and-tube type evaporator by a Refrigerant 22 primary system of about 5½-ton capacity (at –50 F evaporator conditions). The primary system uses a 25-hp, two-stage, reciprocating compressor, with flash intercooling, a subcooler, suction line heat exchanger, and water-cooled condenser. A simplified flowsheet of the system is shown schematically in Fig. 1.

Automatic capacity control and unloaded starting are provided through use of unloading type suction valves actuated by the discharge gas. All of the primary refrigeration system equipment is located outside the reactor shield and is accessible for maintenance.

SECONDARY REFRIGERANT

It was decided to use a chilled liquid circulating system for cooling the equipment inside the reactor cell rather than a direct expansion system because: (a) relative elevations would make it difficult to assure lubricating oil drainage from freezer units, and, in addition, the oil would be subject to radiation damage; (b) the single phase type system permits a wider choice of fluids to meet the stringent design conditions; (c) a thawing arrangement for the cold traps could be conveniently provided by circulating a warm stream of the fluid through the same supply and

Roy C. Robertson is Design Engineer, Reactor Experimental Engineering Div, Oak Ridge National Laboratory. This discussion is based upon "Cold Traps, Freeze Jackets and Refrigeration System Used in the HRE-2" as presented at ASME Nuclear Engineering & Science Conference, April, 1959. The Oak Ridge Laboratory is operated by the Union Carbide Nuclear Company for the Atomic Energy Commission.

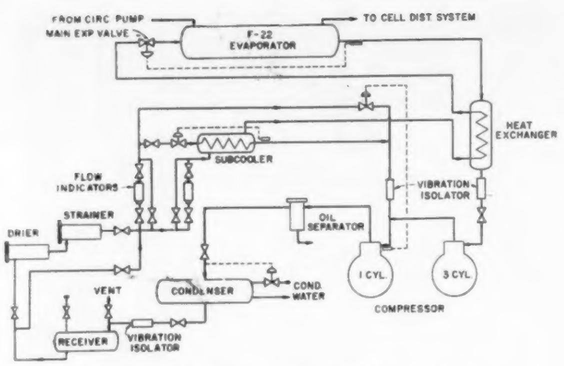


Fig. 1 Primary refrigeration system

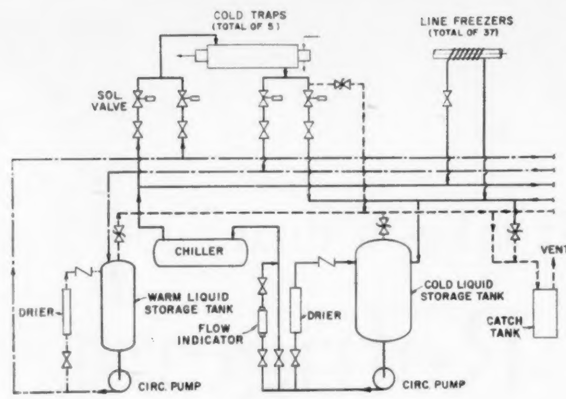


Fig. 2 Secondary refrigerant circulating system

return lines; and (d) connections could be easily made to the circulating system to supply temporary refrigeration to the freezer units used only for maintenance operations.

It was initially planned to use Refrigerant 11 as the circulated liquid. Subsequently, however, halocarbon compounds were demonstrated to break down under irradiation, and it was necessary to find a substitute secondary refrigerant suitable for the design pressures and other characteristics of the existing system designed for the Refrigerant 11.

In selecting a substitute secondary refrigerant it was desirable that it have the physical properties of: (a) a freezing point well below –50 F, (b) a viscosity of less than 30 cp at –40 F to allow reasonable pumping requirements, (c) a vapor pressure of less than 100 psig at 100 F to meet the allowable design pressure in the system, (d) a flash point higher than about 120 F, (e) a specific heat in excess of about 0.2 Btu/lb/F, and (f) other physical properties to afford liquid film heat transfer coefficients of better than 20 to 30 Btu/hr/sq ft/F in the cold trap annuli. Just as importantly, it was required that the fluid, in both the virgin and irradiated conditions, not be corrosive to the system; that it contain only a few ppm of chlorides or fluorides (because of the concern for stress corrosion cracking of the stainless steel parts of the system); that under irradiation and/or when heated to about 600 F, no insoluble products be formed; and that exposure of personnel to concentrations of vapor must not be incapacitating.

Most fluids having a sufficiently low freezing temperature (or eutectic point if an aqueous solution) were not usable for a variety of reasons. The fluid judged to be most suitable was a synthetic branched chain hydrocarbon in the C_8 to C_{12} range (Amsco 125-82) available with carefully controlled analyses. Table I gives selected physical properties, which are quite similar to those of kerosene. Triethyl phosphate was satisfactory in all respects except that of forming an insoluble residue when evaporated to dryness at about 600 F. Liquid carbon dioxide could not be used because the system was designed for only 100 psig; future installations will undoubtedly give serious consideration to the use of carbon dioxide even at the expense of the 1500 psig design pressure.

The hydrocarbon secondary refrigerant was irradiated at room and at boiling temperatures to a level of 1.92 watt-hr/ml (3.7 x 10^{16} Mev/ml) in an electron beam from a Van de Graaf generator to a radiation dosage equivalent to use in the reactor for two to four years, depending on the reactor power level. The viscosity increased during the irradiation, as shown in Table II, and there was some gassing, but no residues were formed which were not soluble in the parent fluid. There was an odor change and a pale yellow-brown color was imparted.

The viscosity increase at low temperatures was not considered to be serious, nor was the high gain in viscosity at boiling temperature of great concern because only a small percentage of the total liquid in the system would be heated to high temperatures. When evaporated to dryness at about 600 F, the virgin fluid left no residue, but the irradiated samples evaporated to a yellow, viscous liquid; this readily dissolved in fresh liquid, however. Samples of the materials used in the circulating system were immersed in the secondary refrigerant for a protracted period without apparent ill effect. Spectrographic analysis of the fluid indicated less than 1 ppm of chlorides in the commercial grades.

SECONDARY CIRCULATING SYSTEM

A greatly simplified HRE-2 secondary refrigerant system flowsheet is shown in Fig. 2. The liquid is pumped from the insulated storage tank at about –20 F to the shell side of the main evaporator, or chiller, where it is cooled to about –40 F.

Since water is practically insoluble in the secondary refrigerant, silica gel driers were included in the circulating system to minimize corrosion and the danger of line stoppages due to accumulated ice crystals. The circulating pump is a 3-hp, 45 gpm capacity (at 160-ft head), centrifugal type with a mechanical shaft seal, and a special 18-8 Cr-Ni steel shaft for low-temperature application. It is of interest that a canned motor pump was considered for this system. A 3-hp canned motor would have a notably low efficiency of about 30% (combined electrical and mechanical) and would thus reject about 19,000 Btu/hr into the pumped fluid. This compared unfavorably with the conventional pump used, which rejects only about 8,000 Btu/hr into the fluid.

The chilled liquid is pumped

TABLE I—SECONDARY REFRIGERANTS—SELECTED PHYSICAL PROPERTIES

Classification		Branched-Chain Hydrocarbon
Flash Point		128 F
Vapor Pressure	—25 F	0.0005 psia (n-Decane)
	72 F	0.0180 psia (n-Decane)
	100 F	0.0721 psia (n-Decane)
Boiling Temperature at Atmospheric Pressure		352 F
Freezing Temperature at Atmospheric Pressure		—67 F
Viscosity	—20 F	5.62 centipoise
	80 F	1.30 centipoise
Liquid Density	—20 F	47.20 lb/cu ft
Specific Heat	—20 F	0.40 Btu/lb/F (est.)
	72 F	0.46 Btu/lb/F (est.)
Thermal Conductivity	5 F	0.085 Btu/ft/hr/ft²/F
Water Solubility at 32 F		Insoluble
Oil Miscibility		Good
Calculated Heat Transfer Coefficient In Cold Traps (for wall heat)		31.7 Btu/hr/ft²/F
Estimated Circulation Rate Required		8.3 gpm
Estimated Friction Loss Due to Flow		0.096 psi/ft

to two manifold stations for distribution to the various points in the reactor cell. There are five cold traps and thirty-seven line freezer units permanently connected to these stations. The warm supply of the liquid, used for thawing the cold traps, is similarly connected to the manifolds, and uses a 3-hp circulating pump of 10 gpm capacity (at 44-ft head). Flow to the cold traps is programmed by solenoid valves on the supply and return lines, these valves being actuated by time switches. Since it would be possible through malfunction of some of these valves to trap liquid between two closed valves, rupture discs or spring-loaded relief valves have been included at all such locations. These reliefs discharge into a vented catch tank provided with a float-operated alarm switch.

SYSTEM CONTROL PANEL

Since a reliable supply of refrigerant is important to reactor operation, a rather complete control panel was installed to permit ready indication and diagnosis of troubles in the refrigeration systems. As shown in Fig. 3, the panel is of the graphic type and diagrams the flows in both the primary and secondary systems. The time switches for programming the cold traps are located behind the access doors in the upper part of the panel. The positions of the four off-gas valves at the outlets of the cold traps, and of the sixteen solenoid valves in the secondary refrigerant supply and return system, are shown by lights on the panel. A 12-point recorder may be plugged into a patch panel of 48 thermocouple stations to record temperatures throughout both systems. The temperatures of the off-gas streams from the cold traps are continuously monitored and annunciated in the main control room should the temperature of an in-service trap exceed about 0 F.

LINES AND INSULATION

Insulation of the refrigerant lines inside the reactor cell presented special problems since the material is subject to high radiation levels and the reactor cell is flooded with water for maintenance operations. Besides the obvious requirement that the insulation remain dry to maintain low thermal conductivity, it is also important that no particles of irradiated material in the reactor cell be allowed to float to the surface of the water when the cell is flooded. Friable types, such as foam glass, therefore, could not be used unless covered. Some insulation materials contain impurities which become strongly activated after neutron bombardment. Most organic type insulation breaks down excessively under irradiation, with off-gassing and increased thermal conductivity.

Expanded mica flakes, silica aero-gel and silicate of lime and aluminum were given the most serious consideration as insulating materials for the refrigeration system. Silica aero-gel was chosen because of its low conductivity ($k = 0.16$ Btu/in/hr/ft²/F at 60 F), and being practically pure SiO_2, is a simple material, which permits the radiation effects to be predicted with more certainty. The aero-gel was in the form of fine granules that poured readily into the pressure-tight galvanized metal cans installed around the cold traps and all refrigerated lines inside the cell. The cans on the lines are about 8 in. diam. The cans are pressurized with air to about 50 psig when the reactor cell is flooded to prevent entry of water into the insulation should any of the soldered joints leak. The cans terminate about 12 in. from the freezer units on the process lines and the remaining distance, and the freezer itself, are insulated with loosely-wrapped aluminum foil. This arrangement affords sufficient flexibility between the process line, which moves with temperature changes, and the relatively rigid insulation cans.

PROCESS LINE FREEZER UNITS

Four different types of line freezer units are used in the HRE-2. Type A, as shown in Fig. 4, consists of wound coils of stainless steel tubing, heliarc-welded to those process lines that approach 575 F operating temperatures. Type B freezers are coils of copper tubing wound around the process pipes and are used on lines which operate at cooler temperatures. In some cases, the interstices between the coil and the pipe were filled with poured lead. Type C freezers are not permanently connected to the chilled liquid circulating system, as are the Types A and B, and are used at points where freezing is required only during underwater maintenance operations.

TABLE II—VISCOSITY OF VIRGIN AND IRRADIATED SECONDARY REFRIGERANT

	At Room Temperature	At —40 F
Virgin	1.4 cp	8.2 cp
Irradiated at room temperature	1.5 cp	12.5 cp
Irradiated at boiling temperature	3.7 cp	37.9 cp

cp = centipoise

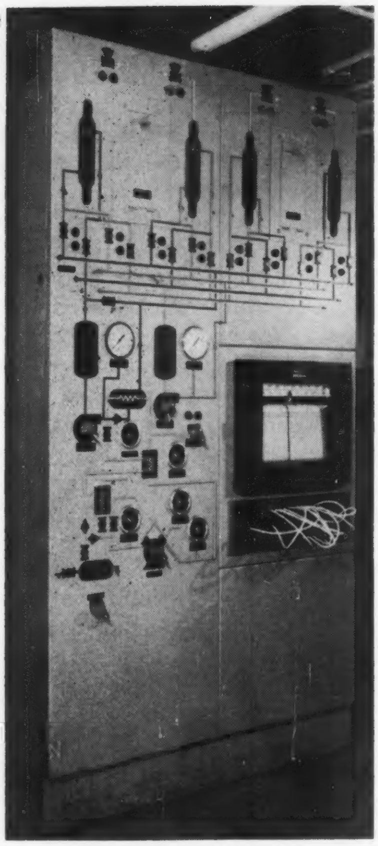


Fig. 3 Refrigeration system control panel

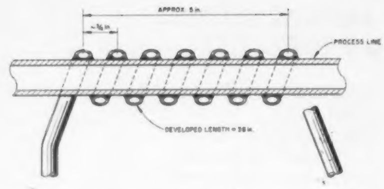


Fig. 4 Type A freezer unit on ½-in. line

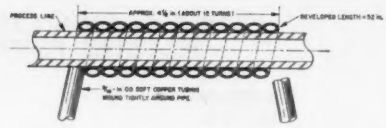


Fig. 5 Type C freezer unit on ½-in. line

The connection points for the supply and return lines for each Type C freezer are inside the cell, above the flooding level. Most of the Type C freezers are copper coils unbonded to the process pipe, as shown in Fig. 5. Type D freezers are split, or clamp-on, jackets designed to be installed by remote tools at locations where no freezing coils were provided. These were constructed of thin brass plate, as indicated in Fig. 6.

In the HRE-2 there are a total of 8 Type A line freezers, 29 Type B, 52 Type C, and several of the Type D jackets for each of the various line sizes.

Freezer designs that circulated the chilled liquid in direct contact with the process pipe were not permitted, since a corrosive situation possibly could be created which eventually might allow highly radioactive fluids to escape from the cell via the circulating refrigerant.

This dictated that the refrigerant be contained in a coil or jacket mounted on the pipe. Tests of various designs showed that the degree of contact of the freezers with the exterior of the process pipe was of greater importance than any other heat transfer consideration. When used under water, the unbonded types performed just about as well as the others, the ice filling the interstitial spaces to improve the heat conductance. Underwater performance of all the freezers is markedly improved by use of aluminum foil insulation to shield them from convection currents in the water.

The length of freezer units used in the HRE-2 varies from six to seven pipe diameters on the ½-in. line sizes to about four diameters on the 4-in. pipes. Above a certain minimum, length had little relation to the time required to freeze a line if there is no flow in the pipe. Tests showed that ½-in. lines could be frozen in 5 to 15 min, and 3½-in. sizes in 20 to 50 min. Tests made of a Type A freezer on a ½-in. Sch. 80 stainless steel pipe, with initial internal conditions of 2,000 psi and 575 F, and a refrigerant supply temperature of about −40 F, showed that only a small flow rate of about 10 cc/min could be stopped with the freezer. It was demonstrated that longer freezer units could arrest higher rates of flow, but since this was not a primary objective in the HRE-2, few quantitative data were collected.

The possibility of bursting the pipes is one of the frequently raised questions regarding application of the freezing technique. In the many tests made of HRE-2 type freezers there were no observed indications of overstressing of the process pipe walls. When freezing commences in a pipe equipped with one of the HRE-2 type freezers, ice first forms on the pipe wall, builds up radially, and first closes the flow area altogether at a point about midway of the freezer length. As freezing continues, the ice plug grows in both directions to finally fill a section of the pipe about equal in length to the freezer unit. With freezing taking place in this fashion there is almost no opportunity for water to be firmly trapped before it is frozen.

The pressure that an ice plug will hold is theoretically given by:

$$p = \frac{2\sigma_s L_f}{r}$$

where,

p = contained pressure, psi
σ_s = sheer strength of ice, psi
L_f = average length of ice plug, in.
r = radius of the ice plug, in.

The sheer strength of ice varies considerably with the amount of occluded gases, conditions of freezing, etc. Some reported values are in the range of 100 to 120 psi; tests made in a ⅜-in. line at ORNL gave roughly estimated values of about 130 psi. According to the above formula, the HRE-2 freezer units were all capable of holding in excess of the 1500 psi design pressure for the system.

The freezer units could not be applied at the flanges any closer than the neck weld in order to not interfere with removal of the flange bolting by remote tools. Light water could thus be included between the ice plugs on each side of a flanged opening when the joint is re-assembled in the flooded cell, and in the case of the larger lines, this entrapped light water could significantly dilute the D_2O in the system. A technique was developed to effectively remove the H_2O from the 3½ and 4-in. flanged joints in the vertical piping at the main circulating pumps. A secondary, collapsible copper gasket is installed in the flanges around the outside of the stainless steel O-ring gasket, and as the bolting is drawn up, this temporary gasket is seated first. Air is admitted through one 1/16-in. diam tubing connection to the gasket and the H_2O is withdrawn through another until the

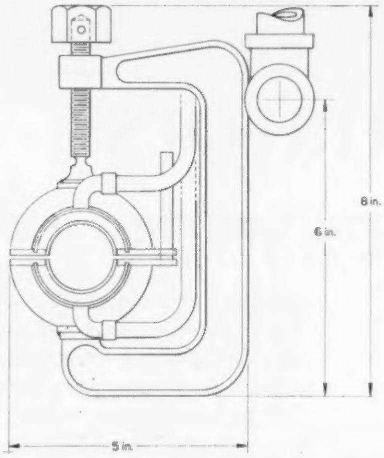


Fig. 6 Type D freeze jacket

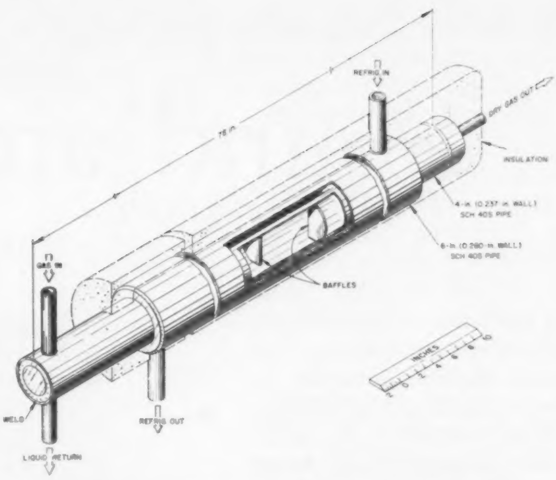


Fig. 7 Cold trap for collecting D_2O

water level is at the elevation of the flange faces. About 90% of the remaining H_2O can then be displaced by the addition of about 2 liters of D_2O through one of the tubing connections while withdrawing water through the other. The flange bolts are then tightened to seat the O-ring and the joint integrity checked with the built-in leak detector system in the usual manner.

COLD TRAPS

The HRE-2 cold traps are concentric 4- and 6-in. Sch. 40 stainless steel pipes about 5 ft long, capped at both ends, as shown in Fig. 7. The D_2O saturated oxygen stream carrying the fission product gases flows through the center pipe at a low velocity of about 5 ft/min, and leaves at an estimated dewpoint temperature of about -10 F. The maximum estimated rate of heavy water collection is about 2 lb per 24 hr.

The refrigeration load imposed by the cold traps is almost entirely that due to the decay heat from the fission products. Based on a gas residence time of 3 min, a gas density of 1.429×10^{-3} at 0 C and 14.7 psia, 0.095 kw of gamma and 0.596 kw of beta energy absorbed (with the reactor at 5-mw power level), the decay heat load is estimated to about 0.7 kw, or 2,360 Btu/hr. Tests made on cold traps, in which the decay heat was simulated by a hot wire down the center, gave an estimated overall heat transfer coefficient of 25 Btu/hr/sq ft/F, using Refrigerant 11 as the secondary refrigerant. A calculated value for the coefficient when using the kerosene-like hydrocarbon as the chilled liquid is about 32 Btu/hr/sq ft/F.

There are two cold traps on the core off-gas system and two on the blanket system. Valves in the off-gas lines permit alternate use of the traps. Time switches control the 36-hr cycle to shut off the gas flow from a cold trap and supply it with warm secondary refrigerant for three hours, during which time the D_2O is thawed and drained. The trap is then supplied with chilled secondary refrigerant for fifteen hours of precooling after which the off-gas flow is resumed and the chilled liquid supply continued for eighteen hours of in-line service.

SYSTEM CAPACITY

Estimations of the heat gains in the supply and return lines for the cold traps were necessarily conjectural, but there was indication that these could amount to as much as 100% of the cold trap load. The total cold trap cooling requirement was assumed to be about 20,000 Btu/hr. Several efforts were made to both calculate and measure the process line freezer refrigeration loads, but the large number of variables, such as line size and contents, etc., made each freezer a special case. One test of a Type A freezer gave an estimated heat pickup of about 1,000 Btu/hr, not including the refrigerant supply and return line heat gains. The underwater refrigeration load of freezer unit on a 4-in. line has been estimated as high as 6,000 Btu/hr. Under normal conditions with four cold traps in service and four to six freezer units in use, the installed refrigeration system develops a capacity of 35,000 to 40,000 Btu/hr, and maintains the secondary refrigerant at -20 F, or lower. The capacity of the primary system is estimated to be about 55,000 Btu/hr at -50 F evaporator conditions.

When freezing the largest lines during maintenance operations, the HRE-2 refrigeration system capacity is augmented by a portable rig, consisting of an insulated 55-gal drum and circulating pump, in which the secondary refrigerant is cooled in a coil immersed in a dry ice-kerosene mixture. This rig has proven to be useful and reliable, producing secondary refrigerant temperatures in the range of -70 to -80 F. The maximum dry ice consumption has been 80 to 100 lb/hr.

How effective are packaged

Sound attenuators

for air-conditioning systems?

ASHRAE publications and its technical committees give recognition to the need for noise control. As noted in chapter 40 of the GUIDE, certain noise control problems involving air-conditioning systems are most economically solved by the use of prefabricated, package attenuators. However, the lack of a uniform method for testing the acoustical characteristics of such attenuators and a scarcity of quantitative acoustical data of any nature have combined to keep such units from being widely used. This paper provides some of the needed information and approaches the following aspects of noise reduction:

1. Definition of noise reduction and an experimental test technique for describing the noise reduction of package attenuators.
2. Description of the physical mechanisms by which noise reduction is obtained.
3. Comparison of the noise reduction vs. frequency characteristics of about 20 commercially available prefabricated units.
4. Some guides for quickly selecting package attenuators to solve a specific noise problem.

An exploratory committee of the American Standards Association and one of ASHRAE's technical committees are undertaking currently to establish standards to define noise reduction and to measure the noise reduction characteristics of package attenuators and other mufflers. The need for standards is obvious. Discussions with manufacturers and other consultants reveal that many different types of testing methods are being used now to establish acoustical characteristics of attenuators. Frequently, the test results are all indiscriminately given the same name (attenuation is a popular term) even though the test procedures are radically different. Further, one may find that two manufacturers use the same test technique, but give different names to the results (noise reduction and insertion loss, for example). It is therefore virtually impossible to select a package attenuator by comparison of technical data.

NORMAN DOELLING

NOISE REDUCTION

Our criterion for defining noise reduction was that the term should be easily related to measurable physical quantities. Our criteria for establishing a measurement technique were: First, the measurements should be repeatable by others, and, second, they should yield results which would aid in prediction, that is, the results should accurately describe the acoustical performance of the units in heating and ventilating systems. In addition, the experimental system should be as simple as possible.

Fig. 1 illustrates the experimental test set-up that was used in this program for measuring noise reduction. The dimensions shown vary somewhat. For example, the distance from the unit under test to the anechoic wedges will be longer for shorter units. Similarly, the duct width becomes smaller for a smaller test unit.

The average sound pressure level (SPL) in each measurement plane is determined from a number of measurements at different positions in the plane. We prefer to use at least three positions for small (6 x 12 in.) ducts and at least five for larger ducts (12 x 24 in. and greater). The number of positions depends also on the symmetry of the unit under test. The noise reduction of the attenuator is defined as the difference in the average SPL measured at the input and output planes which were located as shown in Fig. 1.

NOISE REDUCTION MECHANISMS

Low frequency noise yields changes in air pressure with a relatively slow variation in time. One might assume that losses in low frequency noise arise from the same source as do losses in air pressures which do not vary in time at all. For example, a good way to lose static pressure or to reduce low frequency noise in an air duct is to expand and contract the duct abruptly. To minimize pressure drop, the duct is made uniform in cross section by lining the sides of the expanded section with a glass fiber blanket. The glass fiber lining, of course, provides some low frequency noise reduction but more at mid-frequencies.

Roughly, the noise reduction at low frequencies depends almost entirely on the ratio of the total cross section of the attenuator to the open cross section through which air flows, provided, of course, the length is fixed. The low frequency noise reduction depends but little on other factors of the geometry.

Fig. 2 helps clarify this point. Unit A-1 is a simple lined duct which has an open area of about 55%. Unit A-2 is another version of the lined duct (called parallel baffles or splitters), longer than A-1 but having an open area of about 67%. Note that the noise reduction

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Norman Doelling is a Senior Consultant, Bolt, Beranek & Newman. This paper, here slightly condensed, was presented as "Noise reduction characteristics of package attenuators for air-conditioning systems" at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960. The complete paper will appear in ASHRAE TRANSACTIONS.

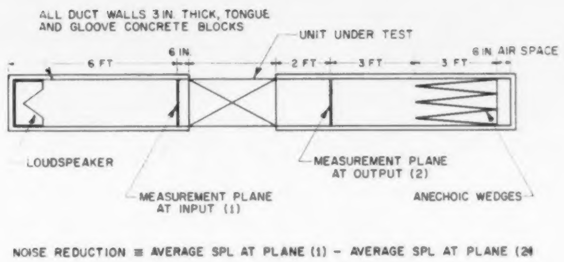
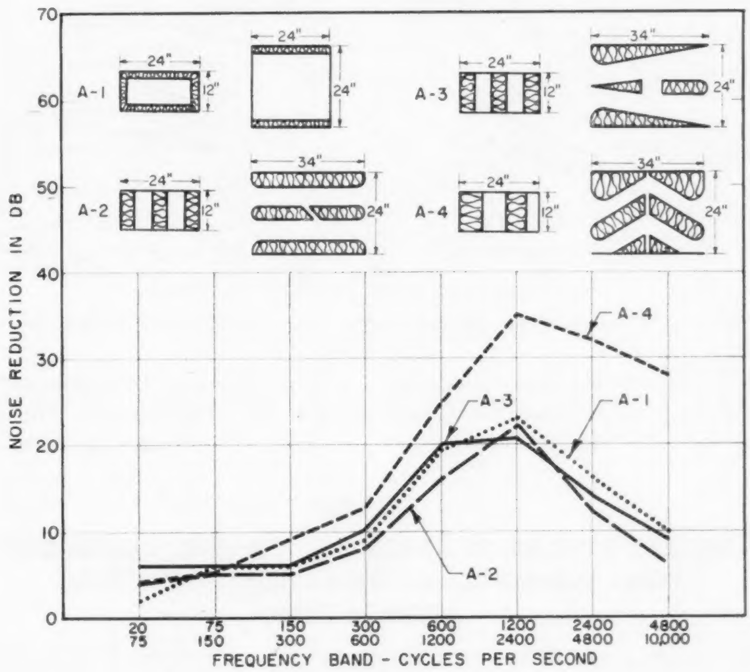


Fig. 1 Experimental test set-up

Fig. 2 Characteristics of four different package attenuators



is somewhat smaller than that of Unit A-1, even though Unit A-2 is somewhat longer than A-1. A similar unit, A-3, is of comparable average cross section to A-2 and the noise reduction is comparable. Generally, the noise reduction of units of comparable size will be inversely proportional to the percentage of open area.

Unit A-4 differs from units A-1, A-2 and A-3 in two significant ways. First, the open area is smaller (about 46%) and a bend has been introduced in the baffles; the noise reduction up to 600 cps increases slightly because of the decrease in open area. Second, a significant increase in noise reduction (above 600 cps) results from the addition of a bend in the unit.

At high frequencies, sound waves behave much like a beam of light. If line-of-sight through the muffler is prohibited, the noise reduction will generally be quite large. High frequency noise reduction depends much more on the bends than on the lining of the duct walls.

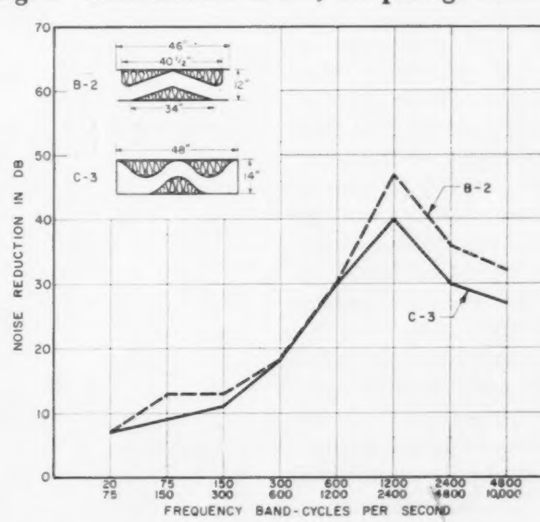
Fig. 3 illustrates the noise reduction characteristics of two mufflers which appear to be of different geometries. However, both have bends and both have roughly the same percentage of open area. As a result the noise reduction characteristics are similar in spite of the different geometries (actually C-3 has a slightly larger average open area and hence a lower noise reduction).

Let us consider how noise reduction varies with length if we hold the cross section, open area, and geometry constant.

An illustration is given in Fig. 4 which shows the noise reduction characteristics of five similar units. Units B-3, B-4 and B-5 incorporate essentially the same construction as B-2, but the length is increased by adding a lined duct section. The noise reduction generally increases with increasing length, but it is definitely not directly proportional to length. For example, the noise reduction of Unit B-4 is not twice as great as Unit B-2 although B-4 is about twice as long as B-2. Note that the percentage of high frequency noise reduction varies little as a function of length. The noise reduction at high frequencies is accomplished almost entirely by the bends.

Unit B-5 has a noise reduction spectrum which is different from that of the other units. In this unit the glass fiber behind the perforated metal duct wall was found to be encased in a flexible plastics sheet. This plastics sheet causes a degradation of the high frequency performance; but the loss of high frequency is not generally important in fan silencing problems. It may, however, be important in speech privacy problems.

Fig. 3 Characteristics of two, 4-ft package attenuators



Severe noise reduction requirements may induce one to put two noise attenuating units in series and assume the noise reduction of the combination is the sum of the noise reductions of the individual units. Generally, this is not a realistic assumption, as Fig. 5 shows. The solid curve gives the noise reduction obtained by adding the measured noise reduction of two model A-4 units and one model A-1 unit. The dotted curve shows the measured noise reduction of two model A-4 units separated by a model A-1 unit. The measured noise reduction of the combination is significantly less than the sum of the individual noise reductions.

Measured noise reduction appeared to be limited by flanking in the 1200-2400 cps band even though these data were obtained in a duct system which was carefully designed and tested to minimize flanking paths. Extreme care must be taken to avoid flanking paths in the field if noise reductions over 60 db are to be obtained.

We have over-simplified the dependence of noise reduction on several parameters and neglected some important parameters such as flow resistance of the glass fiber and percent open area of the perforated facing. However, the considerations above and the data presented below will enable the architect-engineer to estimate quite accurately the noise reduction of units which we have not been able to include here.

Extrapolation to units other than those tested in this program can generally be made easily because almost all prefabricated attenuators are built in module units of about the same dimensions. Furthermore, the flow resistance of glass fiber linings, per cent open area of the perforated facings and other variables generally all fall within the same range. If one finds, therefore, that a unit 3 ft long is claimed to have noise reductions twice as great as the typical values given below, it would be logical to assume that an unusual testing technique has been used.

We have measured the noise reduction of 18 units in our study program over the past year. So far as we know, these units include essentially all product types offered today by three manufacturers.

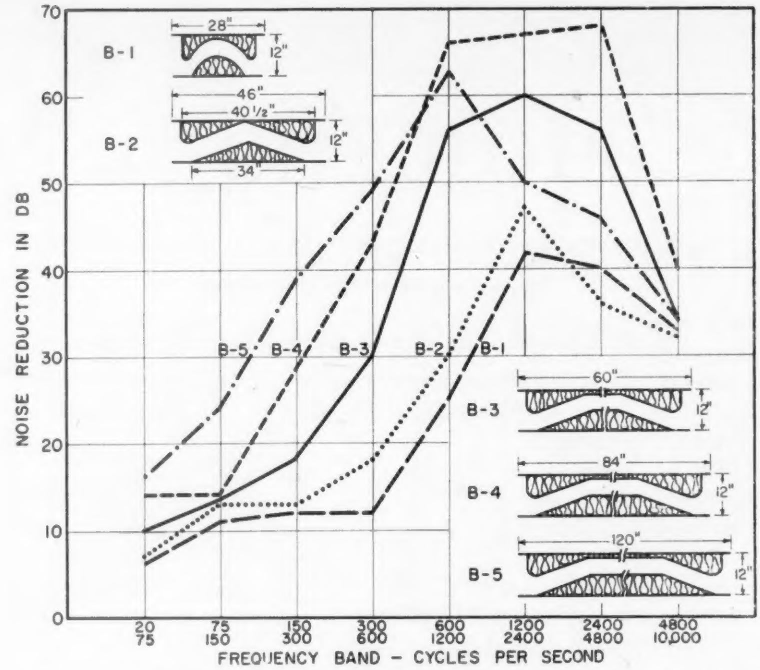


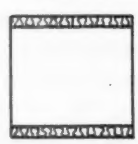
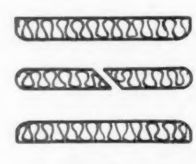
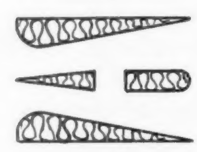
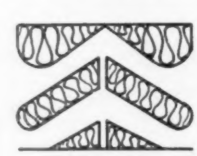
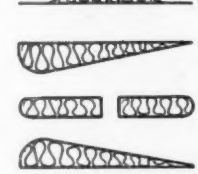
Fig. 4 Characteristics of five similar units which differ in length

Three tables summarize these data.

Data were obtained from modular units of one particular cross section. We had an opportunity to check the same modular unit made with a different cross section. Spe-

TABLE I

OCTAVE BAND NOISE REDUCTION CHARACTERISTICS OF SOME COMMERCIAL PREFABRICATED PACKAGE ATTENUATORS

Unit	Length In.	Cross Section	20–75	75–150	150–300	300–600	600–1200	1200–2400	2400–4800
A-1	24		2	6	6	9	19	23	16
A-2	34		4	5	5	8	16	22	12
A-3	34		6	6	6	10	20	21	14
A-4	34		4	5	9	13	25	35	32
A-5	34		7	7	9	12	24	29	22

(Frequency Bands)

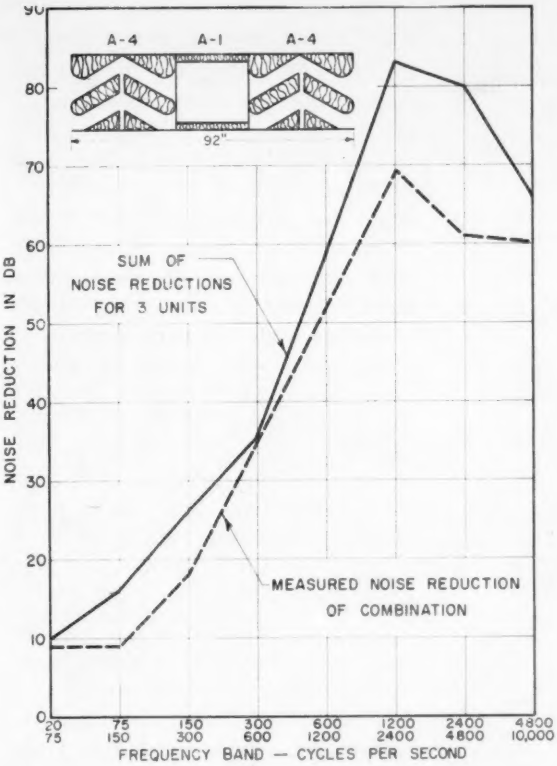


Fig. 5 Series combinations of package attenuators

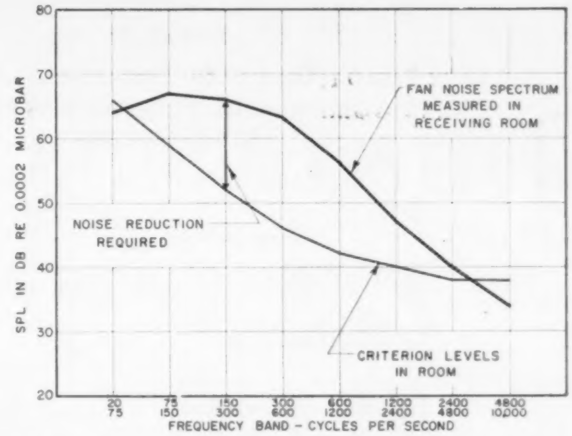
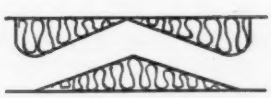
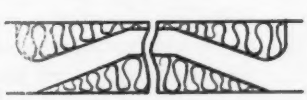
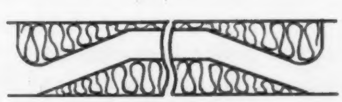
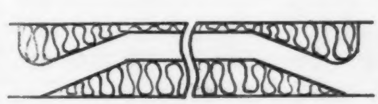


Fig. 6 Typical criterion sound pressure level

TABLE II

OCTAVE BAND NOISE REDUCTION CHARACTERISTICS OF SOME COMMERCIAL PREFABRICATED PACKAGE ATTENUATORS

Unit	Length In.	Cross Section	Frequency Bands 20–75	75–150	150–300	300–600	600–1200	1200–2400	2400–4800
B-1	28		6	11	12	12	25	42	40
B-2	46		7	13	13	18	30	47	36
B-3	60		10	13	18	30	56	60	56
B-4	84		14	14	28	43	66	67	68
B-5	120		16	24	39	49	63	50	46

cifically, unit C-3 had a cross section of 14 x 12 in. A similar unit with a 14 x 24 in. cross section was measured at a later date. The average difference (over frequency) between the two measured noise reductions was less than 1 db. The standard deviation was about 2 db. Actually, flanking problems in the peak noise reduction band existed because the 24 x 14 in. unit did not fit our 12 x 24 in. test duct which was set up at the time. Actual difference would probably be 0.5 db or less and standard deviation about 1 db.

We have not included data for the last octave band in the table. The noise reductions achieved there depend strongly on the mode structure excited by the noise source and large (± 5 db) fluctuations may occur. The loss is not important, as the noise reduction requirements in the last band seldom, if ever, influence the choice of a package attenuator.

As noted earlier, the test procedure minimizes flanking paths. Noise reductions above 50 to 60 db may not be obtained in the field if flanking paths are not controlled.

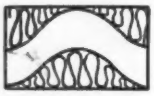
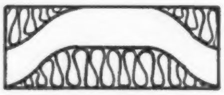
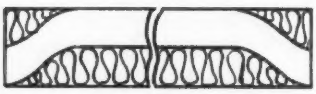
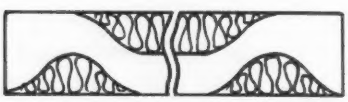
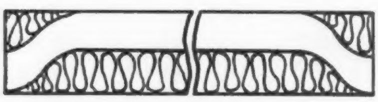
APPLICATION OF DATA

Considering the vast array of data resulting from only three product lines, selection of a package attenuator to satisfy specific noise reduction requirements might at first appear difficult. Let us review briefly the approach presented in the GUIDE to find typical noise reduction requirements for a package attenuator. A power spectrum of a centrifugal fan has a slope of about 5 db/octave. However, the spectrum shape is generally changed by end reflection losses and by reflection losses at bends.

Devotees of high fidelity are

TABLE III

OCTAVE BAND NOISE REDUCTION CHARACTERISTICS OF SOME COMMERCIAL PREFABRICATED PACKAGE ATTENUATORS

Unit	Length Ft.	Cross Section	Frequency Bands 20–75	75–150	150–300	300–600	600–1200	1200–2400	2400–4800
C-1	2		9	9	11	15	25	37	28
C-2	3		11	11	16	19	30	44	38
C-3	4		7	9	11	19	29	40	28
C-4	5		11	12	20	26	45	55	49
C-5	6		10	10	17	25	45	55	44
C-6	8		11	14	25	33	56	62	52
C-7	8		13	15	25	34	59	63	62

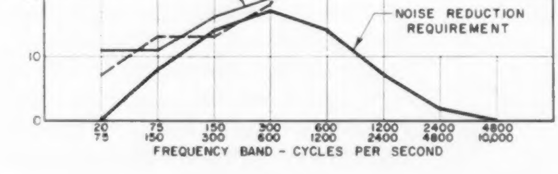


Fig. 7 Noise reduction requirements for the example given in Fig. 6

aware of the difficulty of radiating low frequency sound from a small area. Similarly, it is difficult to radiate low frequency sound from a small outlet grille. This phenomenon, which causes "hi-fi" enthusiasts so much trouble, results in a flattening of the spectrum in the low frequency region as indicated in Fig. 6. The drop in the high-frequency levels is caused by reflection losses at bends in the duct work. We have also plotted in Fig. 6 a typical criterion sound pressure level (NC-40). The difference between the two curves shown in Fig. 6 is the reduction of noise required.

In Fig. 7 we have plotted the noise reduction requirements based on the data given in Fig. 6. This noise reduction spectrum is typical of those required in air-conditioning noise problems. Values of the noise reduction in each octave band may increase or decrease by a fixed amount, but the shape of the spectrum does not vary greatly. If there are several bends in the air path, the high frequency requirements will drop. If the duct sizes are large, then the low frequency noise reduction requirements will be greater than those given here. (For this example we have considered an outlet grille with an open area of about 1 sq ft.)

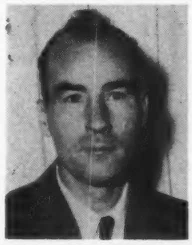
Also plotted in Fig. 7 are the noise reduction spectra of two package attenuators which would satisfy this set of noise reduction requirements. Note that the noise reduction spectra for the units approximately match the spectrum of the noise reduction requirements in the frequency range from 75 to 600 cps. In the first octave band and in the octave bands above 600 cps, one generally obtains much more noise reduction than is necessary to meet a typical noise reduction spectrum. In other words, the noise reduction in the bands between 75 and 600 cps are the only numbers of any real interest. In fact, a preliminary selection of a package attenuator can be made accurately on the basis of the 75-150 cps or 150-300 cps band alone.

If package attenuators were to be rated by a single number, it would seem logical to recommend an arithmetic average of the noise reduction in the frequency bands from 75-600 cps, at least insofar as fans (centrifugal or vane axial) are concerned.

Clearly, there is a great need for standards. Such standards must include not only definitions and techniques to describe noise reduction characteristics but also must consider ways of dealing with noise generation characteristics of package attenuators and the effects of high speed air flow on noise reduction. The latter characteristics are not important in low pressure systems, but they may become important in high pressure, high velocity systems.

What effects do Compressor characteristics have on motor performance?

The driving motor in a hermetic compressor is affected in many ways by the compressor design. Most of these are well known, but the effect of load impulses is only surmised. The primary purpose of the experiments here reported is to show a correlation between load type and motor performance.



ERIK H. JENSEN

Motor manufacturers and compressor manufacturers often find that their data on the same motor do not agree and attribute the difference to test errors. There is, however, a basic difference in the two methods of testing. The motor manufacturer tests the motor on a brake arrangement, which gives a continuous, steady load. The compressor manufacturer tests the motor in a compressor where the load varies from maximum to a much smaller value at least once per revolution.

The most obvious effect of the difference in the test methods is the difference in motor current measured. We have, therefore, based our experiments on measurements of instantaneous and rms motor currents. In order to measure the instantaneous current, a small resistor was placed in series with one of the power leads to the compressor. The voltage drop across the resistor was fed into an oscilloscope as shown in Fig. 1. With this arrangement we obtained pictures of the voltage drop across the resistor and since the resistance is constant, the pictures represent the current.

Fig. 2 illustrates the current for a 2-cyl, 90° V compressor with a single throw crankshaft arrangement, running at 1660 rpm. This differs materially from the simple curve which is obtained from a steady load. Note the change from low to high peaks and a variation from one low peak to the next low peak. In order to portray this better, the sweep time of the oscilloscope was increased, thereby bringing more current cycles within the picture, as shown in Fig. 3.

The pattern became more apparent when the sweep time was further increased, as in Fig. 4. Change in the peak value occurs because the compressor is running at less than synchronous speed. The basic wave represents the 60-cycle current. Superimposed on this is a wave which represents the compressor load variation. When the piston moves up and compresses the gas, it transfers energy from the motor and moving parts to the gas. On the downstroke no energy (or but little) is used. If the maximum piston load coincides with a peak of the ac, there will be a maximum current value. Since the current is 60 cps and the compressor speed a little less than 30 cps, the next peak will occur on the downstroke and it will therefore coincide with minimum torque and be a minimum peak. At the following peak, the piston load is a little behind because of the motor slip and the peak will be less than maximum. This goes on until a new maximum has been reached.

There is no evidence of two cylinder impulses. The reason is that the load from one cylinder overlaps that of the other cylinder in the 90° arrangement under most system conditions, so it may be considered as a single load impulse for this investigation.

This cyclical curve traced by the current peaks can, incidentally, be used to determine the compressor speed. Since the distance between peaks represents ½ revolution of slip, one can count the peaks between maxima – in this case 12. Twelve peaks of 60-cycle current represent 1/5 and the slip is therefore ½ ÷ 1/5 = 2½ rps or 150 rpm. Synchronous speed is 1800 rpm. The compressor speed is then 1800 – 150 = 1650 rpm.

A current pattern similar to Figs. 2, 3 and 4 will always be present when a motor is subjected to a non-uniform load and it follows that the motor cannot perform the same under such condition as under a steady load like a brake.

The next experiments were directed to determining the effect of the size of the load. Fig. 5 shows the current picture at a light load (110 F cond. temp., 20 F evap. temp.) and may be compared with Fig. 6 which represents a heavy load (130 F cond. temp., 50 F evap. temp.).

As the load was increased, the current varied to greater extremes; or, expressed in another way, an increase in load caused the motor speed to vary more and more during one revolution of the shaft.

The following outlines a rough theory for the process during one revolution of the shaft and compares it with test results. The theory may not be absolutely correct, but it serves to show a probable detail picture of the compressor and motor behavior during one revolution. Conclusions, with some limitations, can be drawn from the detail picture to show what should be expected in over-all or rms measurement.

A curve form is assumed for the shaft speed as a function of crank angle, as shown in Fig. 7.

E. H. Jensen is an Eng. Sect. Mgr. in the Air Conditioning Div, Westinghouse Electric Corporation. This paper, here slightly condensed, was presented as "Effect of compressor characteristics on motor performance" at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960. The complete paper will appear in ASHRAE TRANSACTIONS.

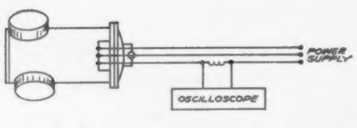


Fig. 1 Oscilloscope

Going from left to right on curve (a), the load increases to a maximum, resulting in a minimum on the speed curve. As the load decreases again, the shaft picks up speed until it reaches the maximum value, where it stays until the load starts to build up again. A heavier load would shorten the time of maximum speed as indicated by curve (b).

Fig. 8 illustrates an ordinary type of power factor curve as obtained on a brake. In order to distinguish the pulsating load power factor and the brake load power factor, we will call the first compressor power factor cpf and the latter brake power factor bpf.

Point b is chosen on the bpf curve as representing the average torque of a pulsating load. If the load corresponds to curve (b) in Fig. 7, the torque variation will be approximately of the same size $\triangle t_b$ to either side of point b. The torque will also be lower than t_b for about the same length of time as it is higher than t_b. Had the bpf curve been a straight line, the resulting cpf would have been the same as the bpf. Since it is curved, however, the decrease r_b will be larger than the increase s_b and the resulting cpf will be lower than bpf.

Point a represents a different situation. It was chosen to correspond to the load represented by curve (a) Fig. 7. In this case the value of r_a is also larger than s_a, but the motor operates at the low torque for a longer period of time. The resulting cpf will therefore be reduced even more than at b. The amount of further reduction will depend on how large a portion of one shaft revolution is spent at minimum torque.

Using this theory, one should expect to find experimentally that:

1. A pulsating load will never give as high a power factor as a steady load for the same total work.
2. If we are operating in the region of (a) Fig. 7, the cpf will increase faster with increased load than if we are operating in the region of (b).

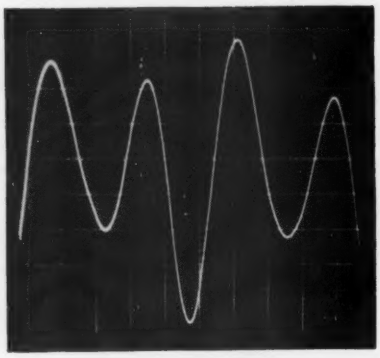


Fig. 2 Current for 2-cyl, 90° V compressor with single throw crankshaft. 1660 rpm

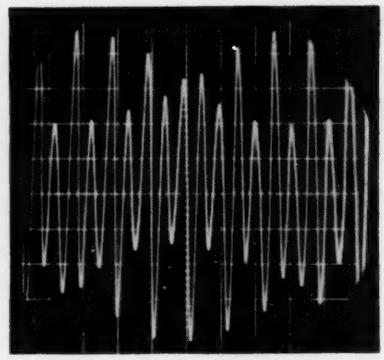


Fig. 3 Sweep time increased

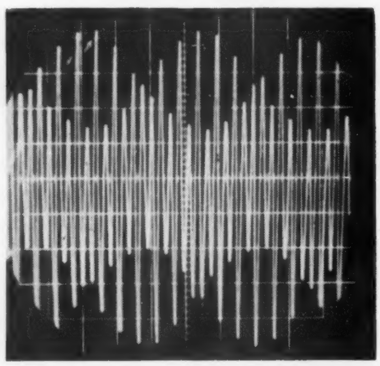


Fig. 4 Change in peak value

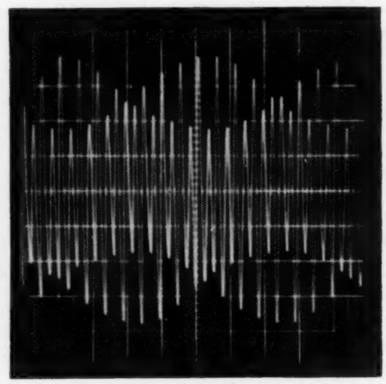


Fig. 5 Light load (110 F cond. temp., 20 F evap. temp.)

Since the motor characteristics and the compressor load type tend to increase the power factor with increased load, we need to determine the relative effect of each. This may be done by dividing the cpf by the bpf. If they are identical, the value will be 1.00. If they are proportional, it will be a constant value. The value will always be less than 1.00 if statement 1 is correct. If statement 2 is true, then cpf/bpf should increase as the load increases, at least in region (a).

A sample calculation based on test values is shown in Table I.

Data from a series of tests were calculated in this manner and the resulting ratios of cpf/bpf were plotted as a function of motor watts. Watts were used to represent load since the power input is quite nearly a straight line function of the torque in the range covered by the tests.

The curves are shown in Fig. 9. Curve B Fig. 9 shows the results from tests of a 3½-ton compressor operating on 3-phase, 60-cycle, 220 volt. Curve A shows the results from the same compressor when it was operated at 3-phase, 50-cycle, 220 volt. The motor was not changed, but because of limiting test facilities the 50-cycle testing was done on 220 volt instead of the 190 volt which would have been proper for 50-cycle applica-

TABLE I

Compressor volt	222	Motor (brake) volt	222
Compressor amp	13.6	Motor (brake) amp	10.50
Compressor watt	3520	Motor (brake) watt	3520

$$\text{cpf} = \frac{3520}{222 \times 13.6 \times \sqrt{3}} = 0.680 \quad \text{bpf} = \frac{3520}{222 \times 10.50 \times \sqrt{3}} = 0.870$$

$$\text{cpf/bpf} = \frac{0.680}{0.870} = 0.783$$

TABLE II

Arrangement	Single Throw Crankshaft	Two Throw Crankshaft
Impulse Spacing	90° & 270°	180°
cpf/bpf	0.898	0.995
Amp	14.3	12.9
Illustration	Fig. 4	Fig. 11

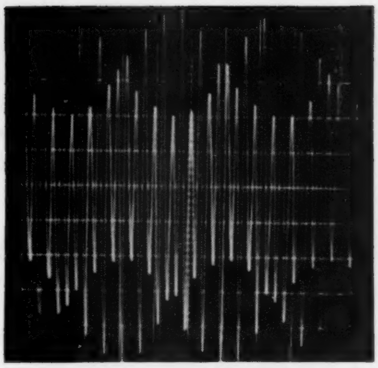


Fig. 6 Heavy load (130 F cond. temp., 50 F evap. temp.)

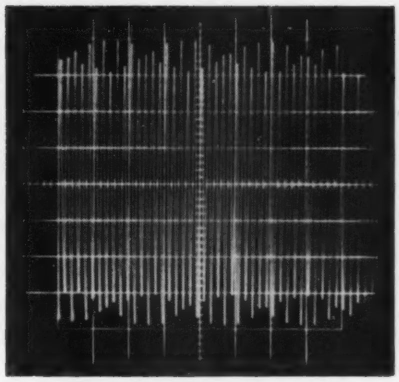


Fig. 10 Picture corresponding to the tests with the flywheel

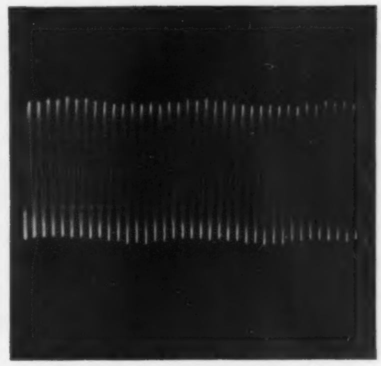


Fig. 11 Two throw crankshaft

tion. In most cases a motor will allow a higher loading at high voltage than at low voltage. The effect of applying a given motor to the same voltage on 50-cycle current as on 60-cycle current is therefore the same as having a higher hp motor available for 50-cycle than for 60-cycle.

With this in mind, it can be seen that curves A and B Fig. 9 indicate that statements 1 and 2 are true: Curve A (50-cycle) shows a definite increase of cpf/bpc with increased load. This would place curve A in the region of operation as (a) Fig. 7. Curve B Fig. 9 shows a nearly constant value of cpf/bpf with increased load. This would place Curve B in the region (b) Fig. 7. While we do not know that the Curves A and B are really the results of operations such as (a) and (b) Fig. 7, it can be seen that the 50-cycle operation, which has the motor with most excess torque available, also has a much greater slope than the 60-cycle operation. Noting that all values of curves A and B are below 1.00, both statements 1 and 2 are therefore supported.

For further confirmation a single test was run with 5 hp motor instead of the 3 hp motor previously used. The 5 hp motor was similar to the 3 hp motor in all respects and the test conditions were identical (60-cycle, 220 volt). The results are shown below:

Motor	3 hp	5 hp
cpf/bpf	0.933	0.710

In other words, by increasing the motor size in a different way, the cpf/bpf again decreased in accordance with the theory.

Three tests were run with the same compressor and the 3 hp motor at 60-cycle to establish the effect of voltage.

Volt	189	231	250
cpf/bpf	0.960	0.915	0.845

This also agrees with the previous findings, further supporting statement 2.

From the theory advanced it would seem that anything one can do to minimize the torque variation Δ_t Fig. 8 will improve the cpf and cpf/bpf. A series of tests was therefore made with the same compressor and 3 hp motor with a flywheel added to the crankshaft. This added about 30% to the moment of inertia of the moving parts. Curves C and D in Fig. 9 show the results. Comparing Curve C with Curve A and Curve D with Curve B leaves little doubt that improvement has been made. Note also that the slope of cpf/bpf changes when the flywheel is added. We have not yet found the reason for this change. We suspect, however, that the flywheel makes the motor operate more in the region of (b) Fig. 7. This would also explain the negative slope of Curve D. Work is being done at the moment to separate the size effect in region (b) and region (a) Fig. 7 more clearly. Fig. 10 shows the picture corresponding to the tests with the flywheel.

It was previously mentioned that the two cylinders in a 90° V single crank arrangement act so that the motor receives the equivalent of a single load impulse. By making a 90° two throw crankshaft instead of the single throw shaft used in the previous tests, we constructed a compressor in which the crankshaft experienced two equally spaced impulses in each revolution. The compressor, motor and test

Fig. 7 Motor speed crank angle curves

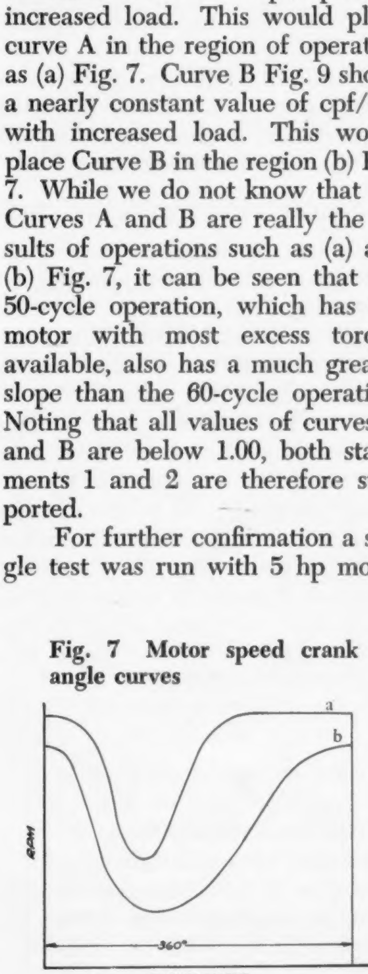


Fig. 8 Ordinary power factor curve as obtained on a brake

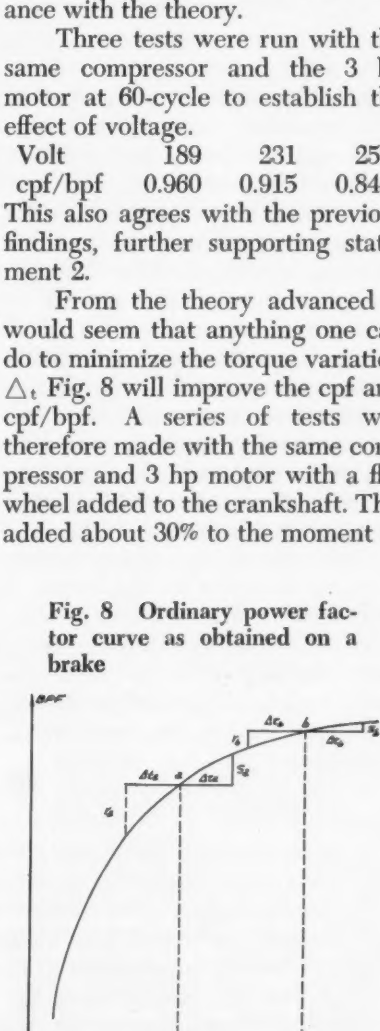
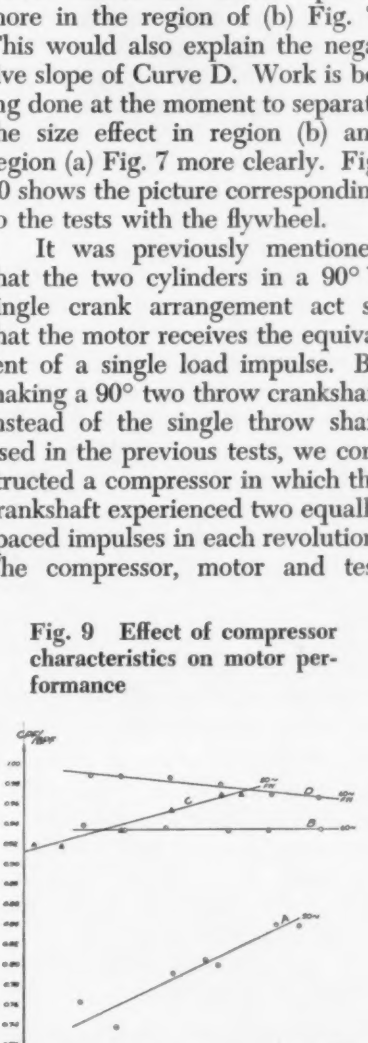


Fig. 9 Effect of compressor characteristics on motor performance



conditions were otherwise the same. Table II shows a comparison of the two tests.

The current readings and oscilloscope pictures show the striking difference between uniform versus non-uniform loading of the shaft in its travel.

CONCLUSION

In compressor design the most important points are:

1. The lowest current drawn for a given load will be obtained with pumping impulses equally spaced.
2. Larger moments of inertia will reduce the current. This may sometimes be accomplished by choosing the larger rotor diameter where more than one is available. It will also serve to caution against adverse effects of changes to lighter materials in the moving parts.
3. Since larger moments of inertia reduce the current, it follows that higher speeds will have the same effect.
4. Motors should be sized as closely as possible to the load and not oversized.
5. High voltages will cause more adverse effects on currents on a pulsating load than on a steady load.

Improved comfort

through radiant heating and cooling

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The human body is a generator of heat, and in order to maintain normal functioning, the rate of loss from the body must be equal to the rate of generation. Heat is lost from the body by (a) convection to the ambient air, (b) radiation to surrounding surfaces and (c) evaporation.

Evaporation is of major importance only under conditions in which the body produces appreciable quantities of water. Otherwise, water will not be available for evaporation and no heat loss will take place by this means from the body surface. Heat is lost by evaporation from the body through exhaling humid air. The amount of energy lost through respiration is relatively small compared to the potential loss by evaporation when the body makes available maximum quantities of water.

Loss by convection may be stated as a combination of conduction and convection, both of which are dependent on the temperature difference between the skin surface and the ambient air. The type and thickness of clothing is important in regulating this loss. For clothing materials impervious to air penetration, loss of heat by convection occurs from the clothing surface. Obviously, with thicker clothing and lower clothing surface temperature there will be minimal heat loss. For materials permitting air circulation into the skin, convection occurs at the skin surface at a higher temperature difference, thereby increasing the rate of loss.

Air velocity is important in both cases, as the rate of heat transfer, either from the skin surface or the clothing surface, is greater for higher air velocities. Most clothing materials are hydroscopic in nature and the insulating effect is dependent on the humidity of the surrounding air. For example, a wool overcoat is a better insulator in a dry environment than it would be in a humid environment.

SURFACE TEMPERATURE, TOO

Heat loss by radiation usually is not given adequate practical consideration. For an environment in which a person is reasonably comfortable, losses by the three mechanisms are of the same order of magnitude. A heating or cooling system providing maximum comfort must compensate for the radiant exchange of heat radiation as well as evaporation and convection. A person sitting out of doors under a clear sky on a summer evening may be chilly although the temperature is in the high 70's.

Panel heating and cooling systems offer numerous advantages over convective type systems, but improved comfort is most important. A brief discussion of the heat losses from the human body and how this is influenced by radiant heating or cooling is pertinent to the evaluation of a radiant system. Factors of energy exchange within the enclosure and types of panel construction are examined in relation to human comfort.

Dr. Merl Baker is Executive Director and a Professor of Mechanical Engineering at the Kentucky Research Foundation.

Were he indoors at this same temperature he would probably feel uncomfortably warm. The appreciable heat loss by radiation to the clear sky explains the different sensations of comfort between outdoors and indoors.

This observation suggests, therefore, that consideration be given to the surface temperatures surrounding an occupant within an air conditioned enclosure. If surface temperatures are all approximately the same as the ambient air, the heat loss by radiation and convection may be considered collectively which is the case of the ASHRAE comfort chart. The existence of cold outside conditions in winter reduces the wall surface temperature appreciably below the ambient air.

Radiation from the warmer walls to the colder outside walls also reduces these temperatures below the ambient air, and the enclosure surfaces for cold outdoor weather will be below the ambient air temperature. The practical compensation for cold walls is an elevation of the room thermostat which reduces the convective loss. A reduction in body heat loss by convection is necessary to maintain comfort when the loss by radiation is increased. If the thermostat is located properly, it will be self-compensating because the element is influenced by both the ambient air and radiation from or to the enclosure surfaces.

This compensation is not exercised in practice as most thermostat temperature sensing elements are shielded from radiation, and the thermostat is sensitive only to the air temperature. An unshielded temperature sensing element, located in the geometric center of a room, would sense the combination temperature which would be approximately the same as that sensed by an occupant in this same position. It is not practical, therefore, to locate an unshielded thermostatic element in this specific position, but other representative positions might be selected.

In order to arrive at a definition of a mean radiant temperature for all of the surfaces to which the occupant is exchanging heat by radiation, consideration must be given to the exchange of radiant energy between the occupant and the enclosed surfaces.

Radiant energy is exchanged between an occupant and each of the enclosure surfaces according to the following equation:

$$q_s = 0.174\, A_s e_s \left\{ \left[\left(\frac{T_s}{100} \right)^4 - \left(\frac{T_1}{100} \right)^4 \right] F\underset{s1}{\rightarrow} + \left[\left(\frac{T_s}{100} \right)^4 - \left(\frac{T_2}{100} \right)^4 \right] F\underset{s2}{\rightarrow} + \right\} \quad (1)$$

where subscript s refers to the subject and 1, 2, 3, refers to the room surfaces.

Introducing

$$h_r = 0.174 e_s \frac{\left[\left(\frac{T_s}{100} \right)^4 - \left(\frac{T}{100} \right) \right]}{(t_s - t)}$$

then

$$q_s = A_s h_{r1} (t_s - t_1) F\underset{s1}{\rightarrow} + A_s h_{r2} (t_s - t_2) \underset{s2}{\rightarrow} + \quad (2)$$

also

$$q_s = A_s h_r (t_s - t_{mrt}) = A_s h_{r1} (t_s - t_1) F\underset{s1}{\rightarrow} + A_s h_{r2} (t_s - t_2) F\underset{s2}{\rightarrow} +$$

since

$$F\underset{s1}{\rightarrow} + F\underset{s2}{\rightarrow} + F\underset{s3}{\rightarrow} \ldots\ldots = 1$$

then

$$t_{mrt} = t_1 F\underset{s1}{\rightarrow} + t_2 F\underset{s2}{\rightarrow} + t_3 F_{s3} +$$

Because of the irregular surface of the human body, experimental evaluation of the shape factors from the body to plane surfaces becomes necessary.

An observation of the plots of shape factors with respect to the human body reveals that the mean radiant temperature with respect to an occupant is dependent predominantly on his position within the room. Since the occupant moves throughout the room, precise determination of t_{mrt} is not realistic for design purposes. A degree of uniformity in t_{mrt} may be achieved by concentrating heating or cooling panels in areas to counteract high intensity heating or cooling. For a room exposed on all sides, a perimeter ceiling or floor panel is highly desirable.

A reasonable approximation for t_{mrt} is obtained by substituting into the previous equation the surface area for the shape factors,

$$t_{mrt} = t_1 A_1 + t_2 A_2 + t_3 A_3 + t_4 A_4 + \quad (3)$$

A comfortable environment is achieved for an air temperature of 76 F with the enclosure surface being at an equal temperature. Recognizing that comfort is dependent somewhat on the individual, air motion and other factors, an exact prediction of comfort is not practical. For design of a heating or cooling panel, the comfort equation is expressed as

$$t_a + t_{mrt} = 152 \quad (4)$$

The constant of 152 is given in preference of 140 recommended by Raber and Hutchinson for heating. Recent data support the value given here and for design purposes adequate heating or cooling capacity is assured. The use of the above equation should be limited to conditions for which the temperature of the air and enclosure surfaces are approximately equal.

Energy balance within enclosures – In calculating the temperature required for a heating or cooling panel, other unknown temperatures involved are the temperatures of each wall of different construction or exposure and the room air temperature. Usually practical dimensions are assigned for the panel, and the requisite temperature computed to satisfy the heating or cooling load. The number of unknown temperatures, equal the number of different surfaces plus 1, require an equal number of simultaneous algebraic equations. These are established by (a) an energy balance on each of the different room surfaces, (b) the room air, and (c) the comfort equation, as expressed in Equation (4).

Consider surface n, any one of the enclosure, and account for the energy exchanges.

$$A_p h_{rp} (t_p - t_n) F\underset{pn}{\rightarrow} + A_1 h_{r1} (t_1 - t_n) F\underset{1n}{\rightarrow} + A_2 h_{r2} (t_2 - t_n) F\underset{2n}{\rightarrow} + A_m h_r (t_m - t_n) F\underset{mn}{\rightarrow} + N_c A_n (t_a - t_n) = A_n C_n (t_n - t_o) \quad (5)$$

where h_r and h_c are the radiation and convection coefficients respec-

tively, F the shape factor, A surface area and t, temperature. Subscripts p, 1, 2, n, m, a, and o, refer respectively to the panel, other surfaces of the enclosure, room air temperature and outside air temperature. C_n is the surface conductance of wall n.

PANEL LOCATION

Panels may be located almost anywhere within an enclosure and more uniform heating or cooling results than from a convective system. As discussed previously, a perimetric location is preferable as this stabilizes variation of the mean radiant temperature as the occupants move about the room. Perimetric locations are not always feasible, because of obstructions of furnishing or the design of the structure. Ceiling panels concentrated adjacent to the most intensive exposures and baseboard panels possibly offer the most satisfactory locations. Floor or wall panels may prove satisfactory in larger buildings, but are usually restricted for practical reasons in small buildings. The transmission of radiant energy from a ceiling panel will produce a floor temperature several degrees above that existing with a convective system. A radiant baseboard produces the most uniform floor to ceiling air temperature gradient. Floor panels must be operated during heating operations at a lower surface temperature than wall or ceiling panels and consequently dissipate a higher percentage of heat by convection.

CONDENSATION

A panel surface exchanges heat by radiation and convection, but being an integral part of the building, condensation and collection of moisture usually is not practical. Moisture may be condensed by a recirculating air coil located within the conditioned space and connected in series with, and before a liquid chilled panel. The dehumidifying coil must have adequate capacity to reduce the dew point temperature below the surface temperature of metallic panels. Panels constructed of tubes embedded in plaster materials, through which vapor is transmitted, must have a vapor seal provided at the warm surfaces, otherwise, condensation will occur within the panel at the tube surfaces. As almost perfect seals are required, the use of plaster type panels are to be discouraged for cooling operations.

An air blanketed metal panel is quite satisfactory for both heating and cooling operations. During cooling, dry air is admitted to the enclosure through perforations, slots or diffusers to reduce the dew point sufficiently to avoid condensation. The selective admission of warm air during heat operation may compensate for areas of intensive heat loss.

. . . panel heating and cooling systems offer numerous advantages over conventional convective systems

. . . loss of heat of convection occurs from the clothing surface

. . . a radiant baseboard produces the most uniform floor to ceiling air temperature gradient

. . . use of plaster-type panels is to be discouraged for cooling operations — an air blanketed metal panel is satisfactory

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Advantages of panel heating and cooling—The following advantages may be listed for panel heating and cooling as compared to convective systems:

1. More comfortable environment
2. More uniform air temperature
3. Cleaner surfaces
4. Neater appearance
5. Improved efficiency
6. More healthful environment
7. More invigorating environment

TYPES OF PANELS

Any surface warmer or cooler than the clothing surface temperature of an occupant will serve as a heating or cooling panel. The surface temperature may be maintained by either embedded flow channels, conveying liquids, a stream of conditioned air sweeping over the backside of the surface, or by indirect radiation with other surfaces. As examples of indirect radiant exchange, a floor is warmed several degrees by gaining radiant energy from a warm ceiling.

Although the floor temperature of this example may not be elevated to the extent sufficient to give heat to an occupant, it will, however, minimize the heat loss from the occupant, thereby creating a higher mrt. The indirect exchange of radiant energy among the surfaces of the enclosure will always increase the mrt for a heating panel and will lower it for a cooling panel. This uniformity is an asset to comfort.

Flow channels spaced at finite distances apart create non-uniform temperature distribution across the panel. The closer together the channels are spaced, and the higher the thermo-conductivity of the panel material, the greater will be the temperature uniformity. Thickness of the panel material also improves lateral conductivity and temperature uniformity. In thick concrete slabs, tube spacing up to two feet is permitted without serious non-uniformities. For a gypsum plaster containing embedded tubes the spacing should not exceed 9 in., and preferably not exceed 6 in. A 4-in. spacing is sometimes used. Aluminum panels represent a satisfactory material because of their high thermal conductivity. Channels may be spaced as much as 2 ft apart for 1/16-in. sheets and a reasonable temperature uniformity maintained.

Aluminum panels designed to serve as a ceiling material, or as a wall section, are practical heating and cooling surfaces. Condensation control is much easier with aluminum panel than with either concrete or plaster containing embedded flow channels. With the aluminum panel the dew point temperature in the room must be below the panel surface, while for the embedded tube the dew point in the room must be below the temperature of the tube surface within the solid material.

Water vapor penetrates masonry materials and condensation would take place at the surface of the embedded tube if the room dew point temperature were not maintained below the surface temperature of the tube. The use of the aluminum panels permits an increased dew point temperature in the room without any danger of condensation. An auxiliary dehumidifying coil must be used to control the room dew point temperature, which is a practical combination if the latent load is low. For

a high latent load an air backed panel is suggested.

Aluminum panels are especially efficient with an air backed system. The panels may be perforated permitting a portion, or in some cases, all of the air to enter the conditioned enclosure. Appropriate slots may be located at selected points admitting part, or all, of the air into the room, or the total quantity of air may be circulated behind the panel and returned to the system as an independent circuit. By admitting part, and in some cases all, of the air to the room, no serious deterrents of the advantages of the panel system occur. Stratification would likely occur if a high percentage of the circulated air were introduced into the room, but this would be less severe than with a typical convection system. All the other advantages of panel heating would be maintained. The admission of air to the room permits accommodation of the load with a lower panel temperature. For summer operation the admission of air to the room in adequate quantities provides a direct control of the latent component as the cool dry air admitted to the room reduces the dew point temperature to a satisfactory value. No danger of condensation exists in this system.

COSTS AND COMFORT

The cost of operating either a heating or cooling panel will be less than with a conventional convective system because of the lower room temperature during heating and the higher temperature during cooling. Saving depends primarily on the rate of ventilation air, as the heat required to raise or lower the temperature of the ventilating area is proportional to the temperature difference between the inside and outside. In some constructions a slight reduction in conductive heat transfer is possible but usually the higher mrt of the surfaces compensates for this predicted saving.

Of greater importance than saving and operating costs is the degree of comfort. As discussed previously, the control of the radiation and the rate of exchange between the occupant and the enclosure are important in producing comfort. During summer operation high temperatures are of even greater significance. A person entering from a hot, humid, outside environment is wearing clothing ladened with moisture. On entering a cool dry environment, evaporation takes place rapidly and the occupant tends to overcool during his initial time in the conditioned enclosure. Occupants who have been in the enclosure for some time would be much too warm if the air temperature were elevated so that the convective heat gain would compensate for the evaporative loss of new arrivals.

... aluminum panels represent a satisfactory material because of high thermal conductivity

... operating costs of both panel heating and cooling systems are usually less than for a convective system

... more uniform heating or cooling results from panels located anywhere within an enclosure than from a convective system

... rate of heat loss from the body must be equal to the rate of generation

A radiant panel would satisfy the entering occupant and those extending their occupancy because of the higher operating temperature. The long term occupants are comfortable because of the increased heat loss by radiation while the occupant, initially with moisture ladened clothing, is not made uncomfortable, as the cooling panel does not increase evaporation. He is more comfortable because the air temperature is now higher, thereby decreasing the rate of evaporation.

CONCLUSION

Panel heating and cooling systems offer numerous advantages over conventional convective systems. For combination heating and cooling panels, an air backed aluminum panel is probably the most satisfactory. This panel is efficient from a viewpoint of energy exchanged, and it may also be designed to replace usual building surface, thereby becoming economical. A higher degree of comfort is experienced in either a panel heated, or panel cooled, environment with the greatest advantage being noted in panel cooling. Condensation may be avoided completely in panel cooling systems if proper engineering design is exercised. Less flexibility is possible with panel cooling systems than with heating systems because of the necessity of designing against the danger of condensation. The operating cost of both panel heating and cooling systems is usually less than for a convective system. The percent saving may be quite high for panel cooling in areas of the country in which only a few days during the summer require cooling. Panel heating and cooling systems have approximately the same advantages for either commercial or residential application.

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46 Years Ago

President Henry Torrance

in Vol. 1. No. 1. November 1914

A. S. R. E. JOURNAL

"The value of any organization to its membership and the community at large depends in a great measure on keeping its membership in close touch with the work it is doing, so that the members will maintain their interest and participate more fully in the work under way.

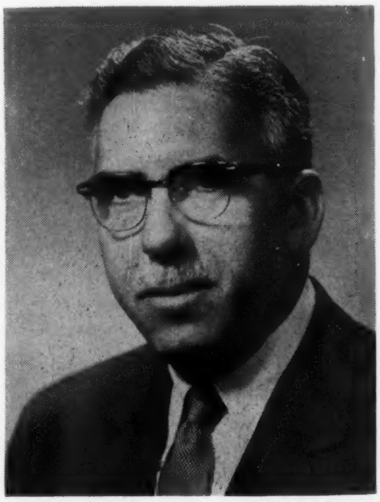
"For many months the Council has had under consideration methods whereby this could be accomplished and a Journal, frequently issued, seemed the first step toward this end.

"We intend to start our JOURNAL while we are still young and thus reap the full benefits."

All of the people

Our membership is growing in numbers at a faster rate than anticipated a year ago, but we must not become complacent. The continued successful and healthy growth of ASHRAE depends to a large extent on how well it serves the needs of all members.

The three basic branches of ASHRAE: heating, refrigerating and air conditioning, are related closely yet many of our members ally with only one branch or possibly only a portion of one of the branches. These members rightly expect to find activities of interest to them at the local and national levels.



D. D. WILE
President

Section 8.8.5 of the By-laws wisely establishes a "watch-dog" Committee to insure that each of the major fields of interest receives adequate attention. Furthermore, whenever 25 members in a Chapter, or 200 members nationally desire to carry out a program at Chapter or national level, respectively, this Committee and the Board of Directors must provide all reasonable facilities.

The protection against onesidedness provided in the By-laws is excellent, but the real success in meeting our obligation stems from a far more basic process. Instead of starting at the top, with the Board of Directors, it starts with the local section and the individual member. It extends through the Region by way of the Chapters Regional Committee, to the Regions Central Committee and thence to the various operating committees. Thus, any member or small group of members can start fast action if they believe that any specific field of interest is being neglected.

In addition to a broad field of engineering subjects, our members represent a wide range of technical levels. In this connection, our membership in the various grades is of interest:

Type of Member	No. of Members	% of Total
Member	7761	40.3
Associate	7785	40.4
Affiliate	3352	17.3
Student	393	2.0

But membership grades do not tell the whole story. We have Full Members whose present activity and interest are almost completely non-technical, yet who have contributed much to the industry and to the Society. We also have Associate, Affiliate, and Student members, whose interests are highly technical. To meet the needs of all our members we must cover a range of technical interests from the highly scientific on the one hand to the highly practical on the other.

A Society such as ours operates largely through committees and every effort is being made to balance the membership of operating committees so that heating, refrigerating and air conditioning are represented properly.

Admirable results are already being accomplished by the Publications and Program Committees in their efforts to meet the interests of all our members while maintaining a high level of technical quality.

Nothing but praise can be said for the efforts of our local Chapters to obtain balanced representation on their committees and officer line-ups, and to provide programs covering the broad range of interest of their membership.

Each branch and each technical level has much to offer our combined operation. The coordination of these diverse interests is of utmost importance to your officers. It is my sincere belief that the continued pursuit of this policy at the national and local levels will insure our successful and effective growth.

Critical velocity emphasized in new study of

Saturated steam flow

in copper tubing

C. M. HUMPHREYS
Member ASHRAE

J. T. BAKER
Member ASHRAE

B. H. JENNINGS
Member ASHRAE

Flow of saturated steam in pipes is not a simple phenomenon, as condensate is always present to a greater or less degree and the presence of this water converts ordinary vapor flow into a complex two-phase flow pattern. Nevertheless, if the amount of condensate is small (say less than 5 per cent of the total weight flow rate) and if the steam and condensate flow in the same direction the error introduced by treating the whole flow as simply vapor is not serious. Unfortunately, this simplification has not been applicable for many of the cases in which it has been employed.

The use of copper tubing for carrying steam has reached commercial significance only for small size tubing. This practice too is rather recent and consequently, data on steam flow in copper are almost lacking in the literature. Although it was not thought that great differences exist between flow in ferrous and copper tubing, some differences are known to exist, and at the start of this investigation there were definite uncertainties about both types.

The theory of flow of fluids in pipes has been studied intensively for many years. The work of Osborne Reynolds, later expanded by Buckingham, made possible the use of dimensionless parameters which could correlate the results of tests with one fluid to predict information for other fluids. The use of one of these dimensionless parameters, the Reynolds number, led to a method of indicating the friction factor, f, for quite a wide range of conditions and fluids.

C. M. Humphreys is Assistant Director of Research, B. H. Jennings is Director of Research and J. T. Baker, Research Engineer, ASHRAE Research Laboratory. This paper here published in condensed form was presented as "Saturated Steam Flow in Copper Tubing" at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960. The complete paper will appear in ASHRAE TRANSACTIONS.

Prior to this period of having the friction factor available in terms of the Reynolds number, for a wide range of conditions, various approximations for the value of f were in use. Most of these took the form

$$f = k\left(1 + \frac{B}{d}\right) \qquad (1)$$

where f represented the friction factor (dimensionless)

k and B were constants for a given medium

d was the pipe diameter in appropriate linear units

The pressure loss resulting from fluid flow was early observed to be proportional to pipe length, inversely proportional to pipe diameter, and to vary closely as the square of the mean fluid velocity. The resulting equation for pressure loss from flow is attributed probably first to H. d'Arcy (1857).

$$h = f\,\frac{L}{d}\,\frac{V^2}{2g} \qquad (2)$$

where

h = loss of head, in feet of fluid flowing

L = length of pipe run, feet

d = internal diameter of pipe, feet

V = fluid velocity in feet per second (fps)

g = 32.17, the gravitational constant

f = the friction factor, dimensionless, read from a friction factor chart such as that of Pigott or Moody in terms of the Reynolds number, N_{Re}

The Reynolds number is represented by the relationship

$$N_{Re} = \frac{V d \rho}{\mu} \qquad (3)$$

where, with V and d having the units above

ρ the density, has units lb per cu ft

μ the viscosity, has units of lb per ft sec

With viscosity μ^1 expressed in centipoises

$$N_{Re} = 1488\,\frac{V d \rho}{\mu^1} \qquad (4)$$

To express the pressure loss, Δp in lb per sq in. from h of the d'Arcy equation (2)

$$\Delta p = \frac{\rho h}{144} \qquad (5)$$

With the appropriate density and viscosity of a given medium such as steam, water, ammonia or air known, it is easy to calculate the Reynolds number for given velocity, and with the Reynolds

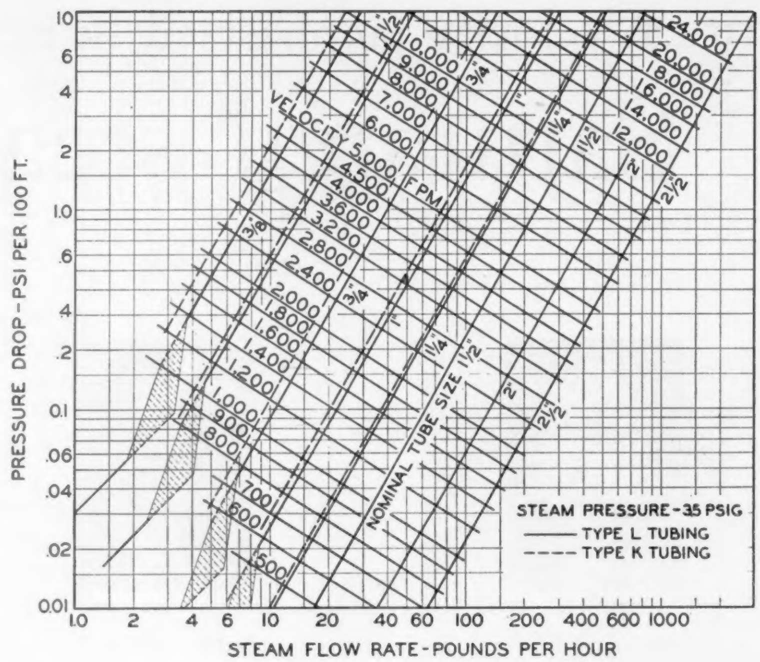


Fig. 1 Flow chart for 3.5 psig steam in copper tubing

number at hand, the friction factor can be found from a chart such as that of Pigott or Moody. With this factor inserted in the d'Arcy equation, it is readily possible to obtain the pressure loss for a given set of flow conditions. The advantage of this approach is that even though the original test data were obtained for air or for water, if the appropriate viscosity and density of steam are known, it is possible to use such generalized data to determine values for steam.

Computed capacity of copper tubing – Data on the capacity of supply and return piping in the various parts of a steam heating system are essential to the designer of such a system, and where steam and condensate are flowing in the same direction, it is customary to size the pipes on the basis of pressure loss.

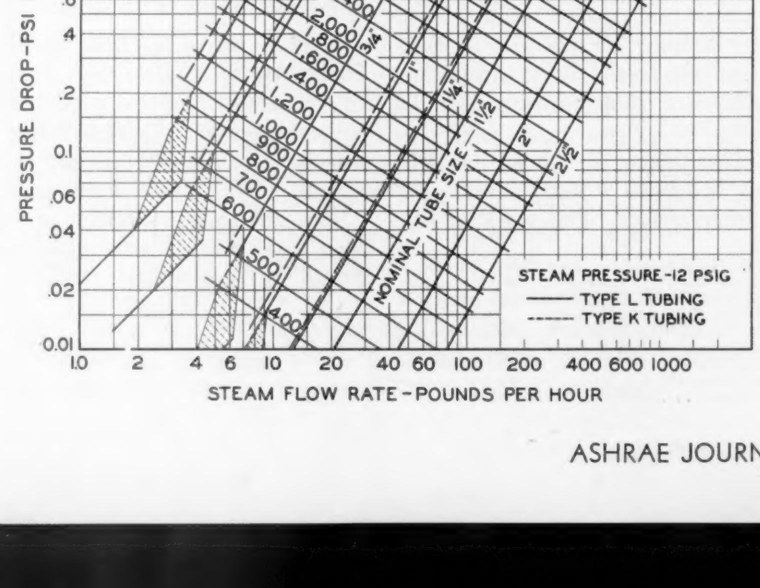
However, for those parts of the steam piping in which steam and condensate flow in opposite directions, the steam velocity must be kept low enough so that it will not interfere with the counter-flow of condensate. For this condition which cannot be computed, data on the capacity of counter-flow steam lines were found from tests carried on at the ASHVE Research Laboratory a number of years ago.

A first step in the preparation of this paper was to use the analytical approach, described in the first part of this paper, to compute the capacity of small-size copper tubing (2½ in. and under). These computations were made by determining the Reynolds number, using it to find the friction factor and then by means of the d'Arcy equation, finding respective pressure drops. The results are plotted in Figs. 1 and 2.

Steam pressures of 3.5 and 12 psig were selected respectively for the computations for Fig. 1 and Fig. 2 to be consistent with tabular data on the steam flow in ferrous pipe in the 1959 GUIDE. As pointed out in the GUIDE, flow rates shown for 3.5 psig can be used for saturated steam at pressures from 1 to 6 psig, with an error not exceeding 8 per cent. Similarly, Fig. 2 for 12 psig may be used for steam pressures from 8 to 16 psig with the same accuracy. At low flow rates in some of the smaller tubes shown in Fig. 1 and 2, flow conditions are in the critical zone. In this zone, shown shaded in the figures, friction loss is unpredictable. Above this zone, the flow is turbulent, while below it, the flow is laminar.

It is recognized that the steam flow data presented in Figs. 1 and 2 are for idealized conditions which never exist in a heating system. They are strictly applicable only to the case where dry saturated steam is flowing throughout the length of the line. In practice, the steam entering the line from the average heating boiler is seldom completely dry, and the steam quality decreases as the distance from the boiler increases, because of heat loss from the line and the accompanying condensation of steam. Since no analytical method is known for determining the pressure drop resulting from the flow of low-quality steam with varying amounts of moisture, a test program was undertaken to determine such pres-

Fig. 2 Flow chart for 12 psig steam in copper tubing



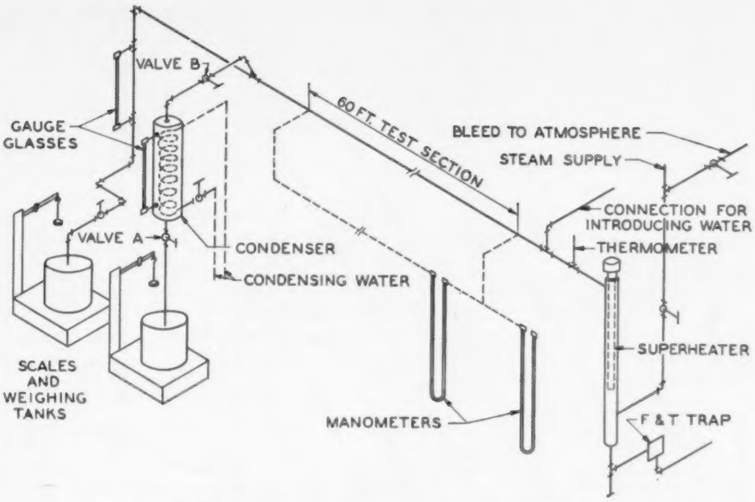


Fig. 3 Schematic arrangement of test equipment

sure drops by actual measurement.

Experimental apparatus – A diagrammatic sketch of the test piping and equipment is shown in Fig. 3. Steam was supplied from the heating boiler and its pressure was maintained constant throughout a test by manually adjusting valves in the main steam supply and in a bleed to atmosphere. Before entering the test section, the steam passed over an immersion-type electric heater, the input to which was controlled by an auto-transformer to maintain approximately 2 degrees of superheat. The temperature of the steam entering the test section was determined by means of a mercury-in-glass thermometer.

A pressure tap was located at each end of the 60-ft-long test section. The pressure of the steam at the entering end was determined by means of a mercury manometer. The pressure drop in the test section was indicated by a manometer filled with a fluid having a specific gravity of 1.75.

The rate of steam flow in the line was determined by condensing the steam and weighing the condensate over timed intervals of 20 to 60 min with the longer runs needed for exceedingly low flow rates. The capacity of the condenser could be varied by flooding a part of the condensing surface to inactivate it. A gage glass at the side of the condenser indicated the height of the condensate in the shell, and this height was maintained constant throughout a test by manually adjusting valve A.

A drip was provided at the end of the line, and the condensation collected from this drip was weighed. The liquid level in the gage glass on the drip connection was maintained constant throughout each test.

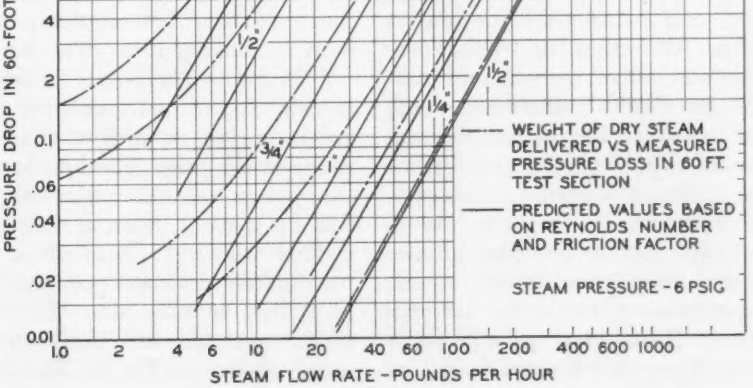
To provide means for studying the effect of varying quantities of condensate, provisions were made for introducing small quantities of water at approximately steam temperature just ahead of the test section. A small all-glass rotameter was used to indicate the rate of water introduction to the line.

Steam flow tests were made with ⅜, ½, ¾, 1, 1¼, and 1½-in. nominal-diameter Type L copper tubing. In all cases the test section was installed with a pitch of 1 in. in 20 ft-0 in., and was uninsulated.

Analysis of pressure loss data—Each tube size was tested at initial steam pressures of 2, 6 and 10 psig, and at a variety of flow rates. At least one no-flow test was made on each tube for each steam pressure to determine the amount of condensation occurring in the line. The no-flow tests were made by operating the system with valve B closed.

The test data were first analyzed on the basis of dry steam delivered at the downstream end of the test section. Since it was known that some of the condensation occurring in the pipe was being carried over with the steam into the condenser, the weight of dry steam was calculated for each test by subtracting the condensation obtained in the no-flow run, from the sum of the weights of condensation obtained from the condenser and from the drip. In Fig. 4 these dry steam weights were plotted against the measured pressure loss in the 60-ft test section, for 6 psig. For comparison, the predicted curves based on the d'Arcy equation with appropriate friction factors are also shown. It will be noted that the differences between observed and predicted values are quite large for the smaller tubes and at the lower rates of flow.

Fig. 4 Comparison of theoretical and experimental flow data



One of the reasons for these large differences is immediately apparent. Although the steam flow at the downstream end of the line was as plotted, the flow at the upstream end was greater by the amount of the condensation collected in the no-flow run. On the assumption that the rate of condensation per foot of pipe was uniform throughout the line, the average steam flow in the test section during each test was calculated by subtracting one half of the condensation collected in the no-flow run, from the sum of the weights of condensation collected from the condenser and the drip. These average flow rates were plotted against pressure loss in Fig. 5. Here we find reasonably good agreement between the experimental and predicted values.

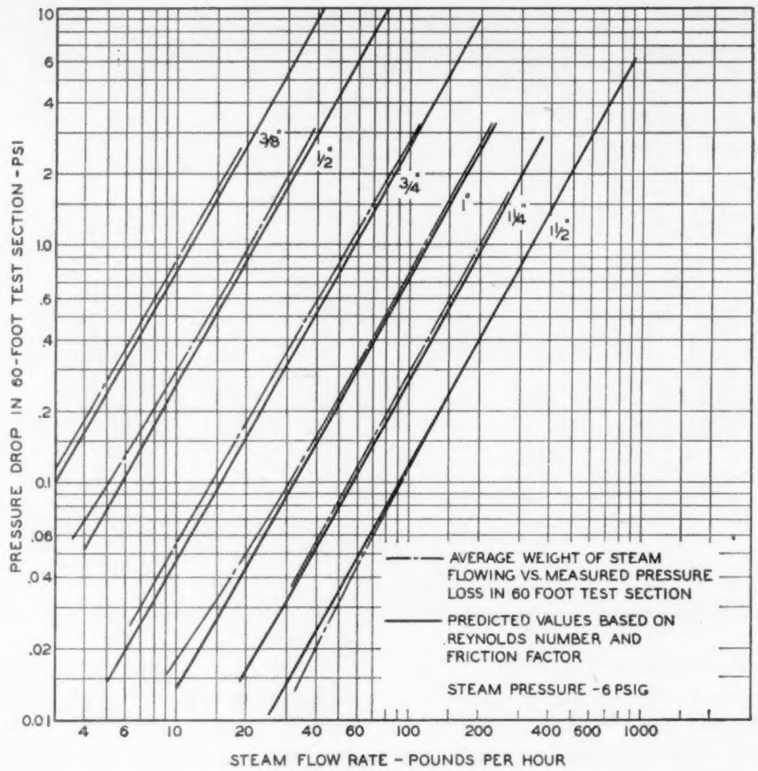


Fig. 5 Comparison of theoretical and corrected experimental flow data

Condensation carry-over—As mentioned above, it was evident early in the program that some of the condensate which formed in the test line was being carried over into the condenser with the steam. A cursory examination of the data indicated sudden large scale differences in the amount of condensate collected from the drip, and a more thorough study of the phenomenon was undertaken.

The relationship between steam velocity in the 1-in. copper line and the weight of condensation collected from the drip is plotted in Fig. 6. It can be seen that for tests made with steam velocities above 40 ft per second, the condensate collected from the drip averaged only about ¼ pound per hour, but that at velocities below 35 fps, the rate of drip was approximately 7 pounds per hour. Different symbols were used in the figure to plot the results obtained at steam pressures of 2, 6, and 10 psig. Distribution of the test points shows that no effect of steam pressure is indicated over this small pressure range.

A few points are shown in Fig. 6 for a series of tests in which water was added at the upstream end of the line at a rate of approximately 9 pounds per hour. These points follow the same pattern established by the other tests. At higher velocities the added moisture was carried over into the condenser with the steam, while at low velocities the water collected from the drip was increased by the amount of water added.

As originally installed, connections to the condenser and the drip at the end of the main were made with steel pipe and malleable fittings of the same nominal size as the copper test sections. The branch to the condenser was taken from the main with a tee looking up at 45 degrees. For these initial piping arrangements, although the general shape of the curves was identical to that of Fig. 6, the critical velocities determined for the various tube sizes varied widely and unpredictably. The lowest critical velocity of 37 fps was obtained with 1-in. tubing while the maximum critical velocity of 65 fps was obtained with 1¼-in. tubing. These velocities were those prevailing in the downstream and of the copper test section. At least one of the reasons for the almost random variations in critical velocity with tube size was undoubtedly the wide variations which exist between the actual internal areas of copper tubing and ferrous pipe of the same nominal diameter. For example, ½-in. Schedule-40 steel pipe has 30 per cent greater internal area than ½-in. type-L copper tubing, while the internal area of 1-in. steel pipe is only about 5 per cent greater than 1-in. type-L copper. However, a recalculation of the critical velocities based on the cross-sectional areas of ferrous pipe made only a slight improvement in the consistency of the relationship between pipe size and critical velocity.

After tests for determining pressure losses had been completed, the copper lines were reinstalled, with copper branches to the condenser taken from the copper main with sweat tees looking up at 45 degrees. Tests were made on these all-copper systems at a single steam pressure of 6 psig, over a range of flow rates only broad enough to establish the critical velocities. The results of these tests, plotted in Fig. 7, indicate that the critical velocity above which condensation is carried out of the branch with the steam, increases in a rather regular pattern with increasing tube diameter.

In Fig. 8 the points of critical velocity for the various tube sizes are indicated on a flow chart for steam at 3.5 psig. The locations of the points on this chart suggest that for a given steam pressure, the critical velocity occurs at an approximately constant pressure loss, regardless of tube size. The 1/16 psi pressure loss line is also prominently shown on Fig. 8. This is the

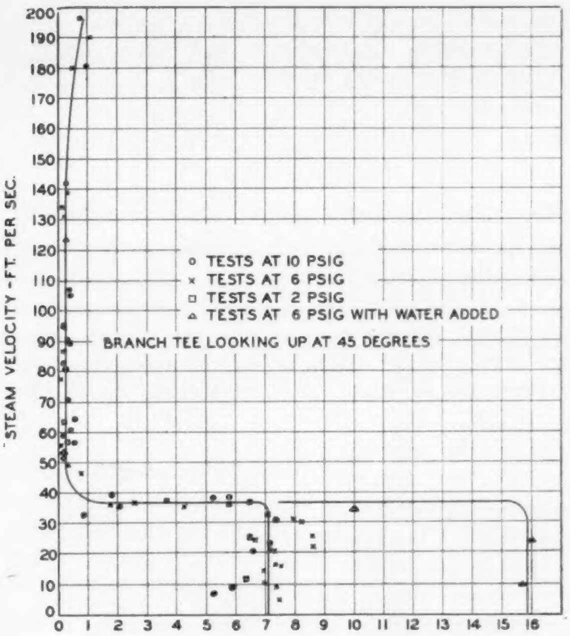


Fig. 6 Effect of steam velocity on the flow of condensate in 1-in., type L tubing

pressure loss recommended in the ASHRAE GUIDE for the design of small steam heating systems. Velocities at this pressure loss are considerably below the critical velocities.

Note that the results of tests in the all-copper system and the original copper-and-steel system were identical for the 1-in. size. This was undoubtedly due to the close agreement previously noted in the internal areas of 1-in. pipe and tubing. Fig. 6 includes test points from both series of tests.

Condensation flow into branches— It was thought that the velocity in the branch might have some effect on the pick-up of condensation by steam entering the branch. To check this, tests were made with 1¼-in. and ¾-in. branches taken from the 1¼-in. main, and with 1½-in., 1-in. and ¾-in. branches taken from the 1½-in. main. It was found that the critical velocity was independent of the branch size, or the velocity in the branch.

In most of the tests, the distance from the center line of the branch to the drip was 6 to 8 in. To make sure that the results obtained were not peculiar to this specific geometry, tests were made on the 1¼-in. main with both 1¼-in. and ¾-in. branches, with this dimension varying from 6 to 26 in. No change in the critical velocity was apparent.

Although the variation in weight of condensate collected from the drip indicated rather definitely that a change in direction of condensate flow took place at the critical velocity, the phenomenon by which this change was effected was a matter of conjecture. To investigate this, an 18-in.-long section of glass pipe was inserted in the 1-in. copper line just ahead of the branch to the condenser. However, this afforded no information on the subject. The stream of condensation could be observed flowing along the bottom of the pipe toward the branch and drip, at steam velocities well in excess of the critical velocity, but little or none of the liquid reached the drip.

A 1-in. glass tee was then installed in the line with the side outlet looking up at 45 degrees, and the connection to the condenser was taken from this outlet. The 18-in.-long section of glass pipe was installed on the upstream side of the tee. A photograph of this glass piping and the near-by equipment and connections is shown in Fig. 9. With this installation, the flow of condensate could be clearly observed, but all attempts to obtain clear photographs of the flow pattern were unsuccessful. The two sketches shown in

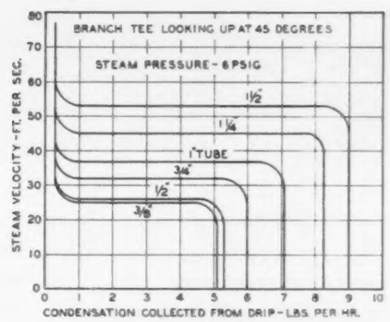
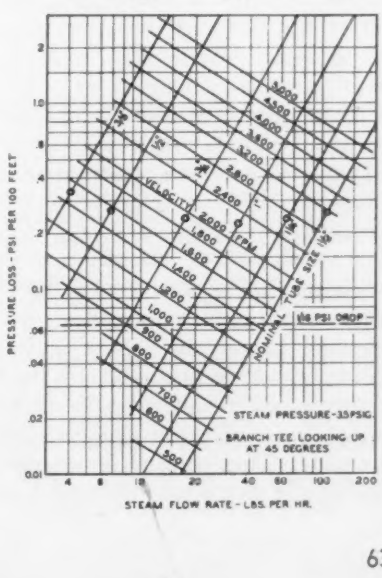


Fig. 7 Critical velocities for type L copper tubes of ⅜ to 1½-in. diam

Fig. 10 were, therefore, prepared.

As indicated in sketch A of Fig. 10, at steam velocities below the critical value, there was a tendency for the condensate level, just upstream from the center line of the branch to rise somewhat. However, the liquid continued to flow from this elevated area to the drip with no visible pick-up by the steam. As the critical velocity was approached this elevated area became more pronounced and more agitated, and occasional drops or small slugs were picked up by the steam and carried into the branch. A further increase in steam velocity caused a continuous film of water to flow up the sloping bottom of the branch following the path or pattern shown in Fig. 10B. With the establishment of this flow pattern, little or no condensate moved to the drip. Still further increases in steam velocity only tended to increase the abruptness of the turn made by the condensate as it flowed into the branch.

Fig. 8 Relationship between critical velocity and pressure loss in type L copper tubing



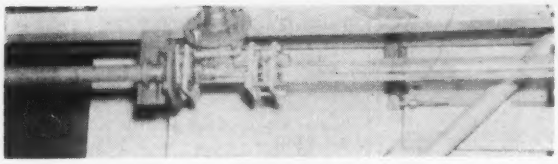


Fig. 9 View of glass pipe and tee in test line

It should be emphasized that all results pertaining to condensate carry-over previously described in this paper were obtained with the branch to the condenser taken from the main with a tee looking up at 45 degrees. Observation of the condensate flow with this piping arrangement suggested that the critical velocity might be dependent upon the angular position of the branch tee. To check this, a few tests were made with two other types of branch connections.

With the 1-in. glass tee installed with the branch vertical, it was found that carry-over of condensate started at a steam velocity of approximately 40 fps, which was only 3 fps higher than the critical velocity determined with the branch tee looking up at 45 degrees. However, instead of a sudden sharp break in the flow pattern, it was found that the amount of carry-over increased with increasing velocity. Complete entrainment was reached at a velocity of approximately 80 fps. The condensate flow pattern, as observed in the glass tee, was very similar to that sketched in Fig. 10 for the 45-degree branch, except that the liquid was moving up both sides of the tee instead of flowing only along the bottom side.

The glass tee was then installed bullheaded at the end of the main, with the run of the tee in a vertical plane. The branch to the condenser was taken from the top of the tee and the drip from the bottom. With this arrangement, carry-over started at a velocity of approximately 70 fps, and increased slowly with increasing velocity. Complete entrainment was reached at a velocity of approximately 175 fps.

Discussion of results – As pointed out earlier in the paper, the relationships shown in Figs. 1 and 2 are in good agreement with test results when comparison is made on the basis of the average steam flow rate. This average flow is the sum of the dry steam delivered at the end of the line, plus one half of the condensation occurring in the line. Usually the designer knows the weight of dry steam desired at various points along the line. The condensation rate can be estimated from performance data included in the GUIDE.

In the design of the average steam heating system, the correction for condensation in the lines can usually be neglected because of a sizable safety factor which results from the common practice of considering published pipe capacities as maximum capacities for a given pressure drop. The load is usually distributed rather uniformly along the length of the main, and a main of a given size will supply several runouts. Only the section of a given size of main nearest the boiler is likely to be supplying a connected load approximately equal to its listed rating. Successive sections will be supplying progressively smaller loads, and the actual average pressure loss will be considerably less than the average drop for which the system is being sized.

In sizing a line to supply steam to a distant building or piece of equipment, the correction for condensation may be more important. In general, the percentage of error which will result from neglecting this correction will increase as the pipe or tube diameter decreases, as the length of line increases, and as poorer insulation is used on the line.

It is evident from Fig. 8 that the velocities in a small low-pressure steam system sized according to GUIDE recommendations of 1/16 psi drop per 100 ft, should be well below the critical velocities. However, many of the recently-installed small steam systems in which copper tubing has been used, have been designed for higher than normal pressure losses. There is little doubt that the critical velocities have been exceeded in these systems. Critical velocities are also exceeded in high-pressure steam systems where much higher pressure drops and steam velocities are commonly used.

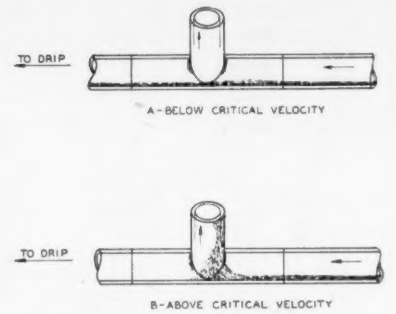


Fig. 10 Sketch of condensate flow observed in glass tee looking up at 45 deg

Information regarding the critical velocity above which condensate is picked up by the steam, may have many applications, some of which may be economic. For example, where steam is purchased, and is measured by a condensation meter, the purchaser should be sure that the velocity in the branch supplying the steam is below the critical value at maximum load. Otherwise, part of his steam costs may be for steam which is condensed in underground lines and not in his building.

CONCLUSIONS

1. Calculated pipe capacities as given in Figs. 1 and 2 show close agreement with experimentally determined values when the comparison is made on the basis of the average steam flow rates.
2. Appreciable error can result if steam flow charts such as Figs. 1 and 2 are used without making proper correction for the condensation occurring in the pipe. This error increases with decreasing pipe size, increasing length of run, and decreasing effectiveness of insulation.
3. For each size of pipe or tubing there is a critical steam velocity, above which condensation is picked up and carried through the branch with the steam instead of flowing along the bottom of the line to the drip.
4. The critical steam velocity as defined in conclusion number three increases with increasing tube size. For tube sizes from 3/8 to 1½-in., it occurs at a pressure loss of approximately 0.25 psi per 100 ft of length.

They Wanted to Know

Inquiries of the month to ASHRAE Headquarters covered many points as to technical facts, standards, practices, personnel and published references. From these, the following have been selected and condensed as being those replies of some general interest and value to ASHRAE members.

COMMODITY FREEZING POINTS

To ASHRAE:

Request information on obtaining literature on the freezing points of various commodities, such as glue, jellies, etc.

G. E. T.

Although the subjects covered are in the general categories of foods and flowers, there is a chapter on Commodity Freezing Points in the ASHRAE APPLICATIONS DATA BOOK. A publication list which will give additional information is available through our sales department. As to the freezing characteristics of glue, this would vary according to the composition of the glue. However, we suggest that you contact the National Association of Glue Manufacturers.

REFRIGERANT 22 LINE SIZES

To ASHRAE:

Would like to secure a chart for the selection of line sizes for Refrigerant 22. While there is information on line sizing in the ASHRAE APPLICATIONS DATA BOOK, it is given in a form of table but not under the form of curves so that it is difficult to make selection for intermediate load and run.

A. P.

Refrigeration Service Engineers Society has a chart on pressure drops in Refrigerant 22 lines which may be of assistance to you if you contact the Educational Director, c/o Hussmann Refrigerator Company. It is possible that the refrigerant manufacturers may have curves indicating the capacities of lines for their various refrigerants. We suggest that you request this information from E. I. duPont de Nemours & Co., Inc., Allied Chemical Corp., and Union Carbide Chemicals Corp.

FREEZING AND STORAGE OF FISH

To ASHRAE:

A client requests data on manufacturers' equipment for the freezing and storage of fish and fishery products.

R. K.

Comprehensive information concerned with freezing or storing fresh or frozen fish is presented in the ASHRAE APPLICATIONS DATA BOOK, with an extensive bibliography. Also a monthly summary of the important developments relative to the fishing industry is published by the Fish and Wildlife Service of the U. S. Department of Interior, titled, "Commercial Fisheries Abstracts". As to manufacturers' equipment, information is available through the National Fisheries Institute.

ANYBODY KNOW?

To ASHRAE:

Can you help us locate the domestic chiller manufacturer identified previously as Prima Products, Inc.? We understand the organization to have been sold or dissolved recently but to be operating under another name.

S. W.

Unfortunately, no. Our records do not supply facts either as to this corporate shift or the acquired responsibility for replacement parts. Can a member-reader assist our inquirer?

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, COMMITTEES

See page 76, September JOURNAL

REGION AND CHAPTER OFFICERS

See page 76, October JOURNAL

RESEARCH AND TECHNICAL COMMITTEES

See page 80, January JOURNAL

STANDARDS COMMITTEE

See page 79, November JOURNAL

INTER-SOCIETY COMMITTEES

See page 66, this issue

TOWARDS A COOLER BREW

To ASHRAE:

An inquiry from England for published literature on cooling beer at the point of dispensing in what is termed a "Flash Cooler". Our correspondent does not know if the domestic coolers would be acceptable in England due to their type of draft beer.

R. E. W.

Beer dispensing equipment called "Flash Coolers" in England is assumed to be the instantaneous Beer and Beverage Cooler as manufactured by Temprite Products Corporation of Michigan. Since there are many arrangements of this cooler, we suggest that you write to P. Ballantine & Sons of Newark, N. J., requesting their full line of literature and catalogs.

HEATING GREENHOUSES

To ASHRAE:

Greenhouse operation is growing rapidly in Canada and many changes are coming about in the control of temperature and humidity, especially since the arrival of European immigrants in this area. However, most local operators have no engineering basis for what they are doing, using the trial and error method in addition to information passed on to them by fathers, etc. I have chosen as a study project, "The Heating of Greenhouses" both of glass and the newer types of plastics construction and would like to know of any papers on this topic.

E. A. A.

We have collected a list of references on this subject which are available in your company library or local engineering library. Of the group, the Cornell Bulletin #906 would be of most use. A copy may be obtained by contacting the Cornell Agricultural Experiment Station. Also of interest might be a paper by Robert S. Ash in the July, 1959 issue of the JOURNAL concerned with the use of evaporative coolers for air conditioning of greenhouses.

FOR LIBRARIES

To ASHRAE:

At what point should the humidistat be set for control in a library, both for winter and summer, to best preserve the book stock? Our new building provides full air conditioning controls but we find differences of opinion as to how it should be operated.

J. E.

Enclosed is a clipping of the chapter from the ASHRAE APPLICATIONS DATA BOOK, referring to libraries and museums. You will note the recommendation of temperatures of 80 F in hot weather, 70 F in cold weather, with relative humidities of 40-50.

ASHRAE INTERSOCIETY STANDARDS REPRESENTATIVES

AMERICAN STANDARDS ASSOCIATION PROJECTS
(Sponsored or Co-sponsored by ASHRAE)

	Representatives:
A-114 Application Standards for Thermal Insulating Materials	**M. W. Keyes,** Chairman
B-9 Safety Code for Mechanical Refrigeration	**R. L. Williams,** Chairman **J. R. Chamberlain** Vice Chairman **S. R. Hirsch** **A. I. McFarlan** **Lee Nusbaum** **J. C. Rehard** Alternates: **W. W. Grear** **A. J. Hess** **W. W. Higham**
B-38 Household Refrigerators and Home and Farm Freezers	**E. C. McCracken,** Chairman **W. W. Higham** **G. S. Hill** **C. E. Lund**
B-53 Refrigeration Terms and Definitions	**G. B. Priester,** Chairman **Harold J. Ryan**
B-59 Mechanical Refrigeration Installations on Shipboard	**W. L. Keller**
B-60 Methods of Testing for Rating Thermostatic & Constant Pressure Expansion Valves	**D. C. Albright**
Z-9 Safety Code for Exhaust Systems	**W. M. Wallace, II** Alternate: **W. S. Bondy**
Z-74 Fundamentals of Performance of Effluent and Gas Cleaning Equipment	**K. E. Robinson**

AMERICAN STANDARDS ASSOCIATION PROJECTS
(Not sponsored by ASHRAE)

A-13 Scheme for Identification of Piping Systems	**Harry H. Bond** **Crosby Field**
A-53 Building Code Requirements for Light and Ventilation	**John G. Eadie**
A-62 Coordination of Dimension of Building Materials and Equipment	**A. W. Knecht**
B-2 Pipe Threads	**S. W. Brown**
B-16 Standardization of Pipe Flanges and Fittings	**G. W. Hudzietz**
B-31 Code for Pressure Piping	**J. L. Wolf** **S. E. Rottmayer** (only on Subcommittee for revision of Sec. 5 Refrigerant Piping)
B-40 Indicating Pressure and Vacuum Gages	**Bernhard Willach**
B-72 Dimensional Standards for Plastics Pipe	**W. J. Olvany**
B-76 Industrial Cooling Towers	**P. A. Bourquin** **John Engalitcheff, Jr.**
B-78 Heat Exchangers for Chemical Industry Use	**C. E. Drake**
C-85 Terminology for Automatic Controls	**C. H. Burkhardt** **K. B. Thorndike**
K-61 Storage and Handling of Anhydrous Ammonia and Ammonia Solution	**C. F. Holske**
S-1 Physical Acoustics	**J. B. Chaddock**
Y-1 Abbreviations	**N. N. Wolpert** Alternates: **R. W. Roose** **C. H. Flink**
Y-10 Letter Symbols	**B. E. Short** Alternates: **R. W. Roose** **C. H. Flink**
Y-14 Drawings and Drafting Room Practice	**F. Honerkamp** **E. R. Wolfert** **H. I. Donovan**
Y-32 Graphical Symbols and Designations	**E. H. Munier** **E. R. Wolfert** Alternate: **C. H. Flink**
Z-11 Petroleum Products and Lubrication	**B. L. Evans** **W. J. Simpson**
Z-17 Preferred Numbers	**D. J. Renwick**
Z-48 Method for Marking Portable Compressed Gas Containers to Identify the Material Contained	**Herbert Wolf**
Z-62 Uniform Industrial Hygiene Standards	**A. D. Brandt**

AMERICAN SOCIETY FOR TESTING MATERIALS

A-5 Corrosion of Iron and Steel	**B. A. Phillips**
B-3 Corrosion of Non-Ferrous Metals and Alloys	**R. C. McHarness**
C-16 Thermal Insulating Materials	**C. F. Kayan** **E. R. Queer**
Planning Committee on Thermal Insulating Materials	**E. R. Queer**

	Representatives:
D-2 Petroleum Products and Lubricants	E. S. Ross
D-3 Gaseous Fuels	E. A. Norman, Jr.
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS	
Subcommittee on the Evaluation of Hermetic Motor Insulation	R. T. Divers R. C. Burns
NATIONAL ASSOCIATION OF CORROSION ENGINEERS	
Intersociety Corrosion Committee	B. A. Phillips F. N. Speller
NATIONAL FIRE PROTECTION ASSOCIATION	
Hospital Operating Rooms	R. P. Gaulin Alternate: N. Glickman
Air Conditioning	A. Giannini
Blower Systems	W. S. Bondy
AIR-CONDITIONING AND REFRIGERATION INSTITUTE	
ASHRAE-ARI Standards Liaison Committee	P. W. Wyckoff A. T. Boggs, III

	Representatives:
D-19 Industrial Water	D. R. Walser
D-22 Methods of Atmospheric Sampling and Analysis	M. G. Kershaw
AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
PTC-23 Atmospheric Water Cooling	A. L. Hesselschwerdt, Jr.
PTC-25 Safety and Relief Valves	M. M. Garland
AMERICAN MEAT INSTITUTE	
ASHRAE-AMI Meat Packing	K. E. Nielsen, Chairman E. N. Johnson B. C. McKenna C. D. Macy F. P. Neff K. E. Wolcott
CANADIAN STANDARDS ASSOCIATION	
Safety Code for Hospital Hazards	J. Klassen

STANDARDS PAGE

Industry standards and the Department of Defense

A. T. BOGGS, III
ASHRAE Technical Secretary

In an address at the annual meeting of ASA on December 9, 1959, Assistant Secretary of Defense, Perkins McGuire, stated that in the future industry specifications, standards, and practices will be adopted wherever possible by the Department of Defense when such industry programs meet DOD needs. Analysis of studies conducted by ASA on behalf of DOD and parallel studies by the Department itself reveal several areas in the government standardization field that could be improved. One of the conclusions drawn from these analyses indicated that in the future the military should not duplicate industry standards. This will mean that a much closer liaison between government and industry standardization groups must be developed in order that conflicting standards will not be promulgated.

Nema Standards: A recent Nema release indicates that a new standard AD1-1959 on **Adsorption Equipment** is available. This new publication covers methods for determining the quality of dry air from (1) an atmospheric pressure adsorption-type dehumidifier in the pressure range of 0 to 10 psig and (2) adsorptive-type compressed gas driers at 10 to 500 psig. It also contains definitions applying to adsorption equipment. Copies are available from National Electrical Manufacturers Association, 155 East 44th St., New York, N. Y., at 30c per copy.

DC 7-1959, **Refrigeration Controls,** is available from Nema headquarters at 30c per copy. This publication describes certain constructional details, classifications, ratings, ranges, differentials and other characteristics of refrigeration controls, capable of handling a current not in excess of 30 amp or handling directly any motor with a rating not higher than 1½ hp dc or single-phase ac and 2 hp polyphase.

ARI Directory: The first 1960 Directory of **Certified Unitary Air Conditioners** has been published and is available from ARI headquarters. This edition includes ratings for 1959 models of 50 participating manufacturers. This program was initiated in 1959 and Managing Director G. S. Jones, Jr., of ARI, has stated that the first year has proven notably successful. Managing Director Jones also stated that a pattern for the routine random testing of units has been established by ARI under which at least four units will be tested every month to determine whether the rated capacities are met by the stock units themselves. At the present time this certification program covers only unitary air conditioners up to 135,000 Btu per hr capacity. It is expected that heat pumps within the same range may be included in the program some time this year or early in 1961.

ASHRAE Standard: A project committee has been initiated to study Standard 18-56, **Drinking Water Coolers.** In line with the present policy of the Standards Committee, the rating information will be deleted and reference made to existing ARI rating standard.

What ASHRAE Regions and Chapters are doing

End of year meetings featured tours by several Chapters, discussions at other meetings of such varied topics as air pollution, international refrigeration and solar energy.

KANSAS CITY . . . "Design, Installation and Maintenance of Mechanical and Related Equipment in Medical Facilities" was the topic presented at the December meeting by Philip Dreifuss, Administrative Engineer of Menorah Medical Center. Discussing problems such as design practices and standards, lack of complete maintenance manuals and patient complaints, he illustrated his talk with slides indicating various installation practices.

SOUTHERN CALIFORNIA . . . Topic for a panel discussion at this joint meeting with the Illuminating Engineers Society was "Integration of Lighting and Air Conditioning."

Kenneth H. Neptune, A.I.A., stated that integration of air conditioning and illumination in one unit would aid the architect in arranging the ceiling pattern. Such light fixture-diffusers would fit well into the modular type unit planning.

This type of unit, according to Alvin Z. Levine, consulting mechanical engineer, is not applicable to all buildings and occupancies. In an office building, an integrated unit would function efficiently in interior zones, but would require extra cfm at the exterior. Exhausting the units to rid the building of the lighting heat load at the source would be a possible solution here, he contends.

To be a good overall system, the module unit, asserted Edward Frumhoff, consulting electrical engineer, must fulfill several requirements, among them architectural, electrical and air conditioning. Lights would be more efficient if partly cooled, but too cold a fixture would lose lighting efficiency.

ROCKY MOUNTAIN . . . Touring the U.S. Air Force Academy in Colorado Springs, Colo., members attending the December 2nd meeting inspected the Administration Building, cadet quarters, academic complex and dining hall. Climaxing the tour was a walk through the distribution tunnel.

First meeting of the new year, held January 6th, featured a panel discussion of packaged bids, specifications and salesmen's contacts with engineers, owners and architects. With John Berger of McCombs Supply Company as moderator, the panel was comprised of Lynn Wray of Paul Koch's office; Clint Cator; John F. McCauley, J. F. McCauley, Inc.; John Cipra, Cipra Air Conditioning & Sheet Metal Company; William Braak, Johnson Controls; and Red Niblack of American Blower.

IOWA . . . Preceding a tour of Meredith Publishing Company's high temperature hot water heating system, conducted as part of the December 8th meeting, Consulting Engineer John Brown delivered a brief talk about the plant and its system.

MICHIGAN . . . Included in the talk of Norb Hall, Chief Engineer, Ready Power Company, who spoke on "Application, design and features of engine-driven compressor systems, using natural gas, as applied to air conditioning and refrigeration," were the sizing of engines and cooling towers, condensers and other components. Advantages and disadvantages of this type of system as compared to electrically operated systems were indicated.

NORTH ALABAMA . . . Air conditioning as applied to rockets and space vehicles was discussed at the December meeting by Robert H. Pettey, Jr., Deputy Chief of Mechanical Design Sect, Structural & Mechanical Laboratory, ABMA, Redstone Arsenal.

CINCINNATI . . . Two addresses, a coffee talk by G. P. Williams of General Electric Company, "Revealing facts about electronic brains and how they affect all our lives," and a longer talk on "The economics of heat pump installations in multi-story office buildings" by T. F. Rockwell, consulting engineer, highlighted the December 1st meeting.

ST. LOUIS . . . Recommended by Dr. Merl Baker, Executive Director of the Kentucky Research Foundation, was the use of conventional ten per in. fin spacing on outdoor coils of residential air-to-air heat pumps, rather than aiding frost formation by

CHAPTER MEETING DATES

	Feb.	Mar.	Apr.		Feb.	Mar.	Apr.		Feb.	Mar.	Apr.
Alamo	16	15	19	Central Pennsylvania	10	—	13	Illinois	8	14	11
Arkansas	16	23	20	Cincinnati	2	2	6	Illinois-Iowa	15	21	18
Atlanta	8	14	11	Cleveland	—	—	—	Inland Empire	8	8	12
Austin	18	17	21	Columbus	15	21	18	Iowa	9	8	12
Baltimore	4	3	7	Dallas	15	21	18	Jacksonville	5	1	1
Baton Rouge	17	17	14	Dayton	3	2	6	Johnstown	9	8	12
Boston	16	15	26	El Paso	—	—	—	Kansas City	1	7	4
British Columbia	—	—	—	Evansville	2	1	5	La Ville de Quebec	8	14	11
Central Arizona	—	—	—	Florida West Coast	16	16	19	Long Island	8	8	11
Central Indiana	—	—	—	Fort Worth	17	16	20	Louisville	8	14	11
Central Michigan	9	8	12	Golden Gate	4	3	7	Manitoba	25	24	28
Central New York	10	9	13	Hampton Roads	—	—	—	Memphis	21	20	17
Central Oklahoma	8	14	11	Houston	19	18	15	Michigan	15	21	18

using wider spacing. Room for improvement was noted in the over coefficient of performance, which might be achieved by improving motor and air handling efficiency.

NEW ORLEANS . . . Utilizing case histories to refute the claim that school buildings equipped with air conditioning are impractical from a cost standpoint, Stanley A. Gray of Minneapolis-Honeywell Regulator Company addressed the December 15th meeting on "Year-Round Air Conditioning in the School." An analysis of costs of both air conditioned and non-air conditioned schools in several areas in the country established that the mechanically cooled structure is actually less costly due to the increased choice of possible building designs.

"Complete air conditioning with temperature and humidity control coupled with modern lighting provides a controlled environment, making a new design concept possible," stated the speaker, expanding this to say that, for example, large window areas with ventilating openings, an expensive element of the exterior walls, could be eliminated or substantially reduced.

Apart from the question of basic construction costs, speaker Gray contends that the air conditioned school provides better educational facilities, with increased teacher and student efficiency and alertness, and expansion of the school's usefulness to include the summer months.

CLEVELAND . . . Placing emphasis on efficiency, life and operating costs, James Rishell, Manager of Atlas Generator and North American Manufacturing Company, spoke on "Design and Application of Steam and Hot Water Scotch Boilers" at this Chapter's December 14th meeting. Efficiency was defined as the total heat transfer (radiant plus convection) divided by input, and the life of a boiler as a function of adequate furnace volume plus ample water volume, proper tube installation and correct rear furnace design. True cost of a boiler, speaker Rishell stated, is not just its initial cost, but this cost plus fuel, power and maintenance analyzed over the expected life of the boiler.

NATIONAL CAPITAL . . . Extensively air conditioned, with two 650-ton centrifugal compressors and 19 low pressure supply fans, the new Washington Star Building was the site of a tour conducted at the December meeting. Prior to viewing the installation, members heard Francis H. Buzzard, one of the engineers responsible for design of the mechanical equipment, describe the building, design criteria for several areas and systems and the manner in which some of the major problems were solved. Noted was the use of well water for linotype machine cooling, in order to secure accurate temperature control. Special automatic devices were provided for discharge of the effluent into the street sewer.

Charles S. Leopold, the second of the design engineers, presented a slide-accompanied discussion of the problems encountered in ventilation of the press room, in particular with respect to the generation of ink mist. Air handling equipment servicing this room maintains it at a negative pressure, with surrounding rooms kept under a slight positive pressure, preventing ink mist and paper dust from exfiltrating into other areas of the building. Air from the press room is exhausted by means of a series of openings above the presses. Entering these openings at 4000 cfm, the air is passed into roll-type filters where ink and paper dusts are removed before the air is exhausted to the roof.

ROCHESTER . . . Use of slides to acquaint members with curves descriptive of fan noise and acceptable noise levels in various types of occupancies highlighted the speech of John W. Overend of the Sound Control Dept of Koppers Company, January's guest speaker. Explaining the different kinds of noise which can be present in an air handling system, he showed how the amount of noise control needed can be decided and how to select the proper type of noise attenuator for the system.

CENTRAL NEW YORK . . . "Trends in American Refrigeration Machinery," a talk first delivered to the 10th International Congress of Refrigeration, was presented by J. F. Downie Smith, Vice President of Carrier Corporation, at the December meeting. In his discussion, Dr. Smith attempted to show the scope of the industry, its advancement and future.

DALLAS . . . Speaking at a recent meeting, C. R. Apitz, Gas Turbine Div of Clark Brothers Company, discussed "Gas Turbines for Profit."

WESTERN MICHIGAN . . . After a brief discussion of the quantities of solar energy striking the earth, frequency distribution and interferences, Claremont D. Engebretson of the Massachusetts Institute of Technology Solar Research Project described the three methods of conversion of these energies:

	Feb.	Mar.	Apr.		Feb.	Mar.	Apr.		Feb.	Mar.	Apr.
Middle Tennessee	9	8	12	Northern Alberta	—	—	—	Savannah	19	15	19
Minnesota	8	14	11	Northern Connecticut	11	10	14	Shreveport	18	17	21
Mississippi	22	28	25	Ontario	—	—	—	South Carolina	15	21	18
Mobile	—	—	—	Oregon	13	17	14	South Florida	9	8	12
Montreal	15	28	19	Ottawa Valley	—	—	—	South Piedmont	—	—	—
National Capital	2	1	5	Philadelphia	11	10	14	Southern Alberta	—	—	—
Nebraska	—	8	12	Pittsburgh	15	21	18	Southern California	8	14	11
New Mexico	16	15	19	Puget Sound	—	—	—	Southern Connecticut	9	8	12
New Orleans	15	15	19	Rhode Island	10	16	20	Toledo	—	7	4
New York	23	29	26	Richmond	1	7	4	Tucson	—	—	—
Niagara Frontier	—	—	—	Rochester	3	2	6	Utah	19	18	15
North Alabama	—	—	—	Rocky Mountain	3	2	8	West Texas	22	28	25
North Jersey	4	3	7	Sacramento Valley	—	—	—	Western Massachusetts	—	—	—
North Piedmont	—	—	—	St. Louis	11	28	25	Western Michigan	8	14	11
Northeastern New York	—	—	—	San Diego	10	10	14	Wichita	16	15	19
Northeastern Oklahoma	15	21	18	San Joaquin	16	15	19	Wisconsin	15	15	18

photochemical, photoelectric and photothermal, giving obtainable efficiencies.

Devoting the majority of his talk to the photothermal method, which was of most interest to ASHRAE members, he covered solar furnaces, broilers and stills, and home heating.

TOLEDO . . . After outlining the Mercury program for placing a manned satellite in orbit about the earth, E. Callaghan, guest speaker at the December meeting, described in detail the design and construction of this proposed space capsule's heating and cooling equipment.

HOUSTON . . . Attempting by means of questions and answers to evaluate the relative costs of installation, maintenance and operation, a panel at this group's last meeting discussed "What is best for the 15 to 75-ton systems – air or water-cooled condensers?" Comprising the panel were Roy W. Maze, Marley Company, Moderator; Dale S. Cooper and Jack Buckley, Consulting Engineers; Sidney Atlas and James Daniel, mechanical contractors; Phillip Ruthstrom, serviceman; and David Dart, Design Engineer, Marley Company.

Under consideration were provisions which must be made for systems operating at temperatures of 32 to 50 and 20 to 30 F, the effect on compressor life, why air-cooled systems are now limited to about 75 ton and how engineers decide which system to use.

BRITISH COLUMBIA . . . Carbon monoxide concentration forms the major problem in air conditioning a tunnel for automobile use, according to guest speaker Carl Haselsteiner, who delivered a talk on the Deas Island Tunnel, for which he was Project Engineer of the Foundation Company. Self-supervising equipment, positioned at sampling points throughout the tunnel, is capable of detecting carbon monoxide in extremely low concentrations. Showing a colored film on the construction of the tunnel, he outlined the method of supplying and exhausting air and its distribution.

RHODE ISLAND . . . Presenting data collected over a long period of time and resulting from analysis of several existing installations, John Rasch of Minneapolis-Honeywell Regulator Company spoke on "Economics of Air Conditioning" at a recent meeting. Conclusion reached was that heating, cooling, humidifying and filtering are all important parts of a system and increase in comfort efficiency justifies the extra expense of a complete system containing each of these.

EVANSVILLE . . . Resulting from his attendance at the 1951, 1955 and 1959 International Congresses of Refrigeration, impressions with regard to "International Refrigeration" were presented by W. T. Pentzer of the U. S. Dept of Agriculture, speaker at the December 1st meeting.

Involvement and increasingly more active participation of the U. S. were discussed, beginning with a delegation to the 8th Congress in 1951. Emphasis was placed on headway made in the development of international codes and standards and exchange of information between countries.

Established in 1908, the International Institute of Refrigeration has published a bimonthly bulletin since 1910, which digests data from many countries, reviews research and presents information on manufacture of equipment. Nine commissions have been set up to cover various phases of refrigeration information and research. These commissions will report at the 11th Congress, to be held in Germany in 1963.

Concluding his address, speaker Pentzer showed slides taken during the 10th Congress in Copenhagen.

Making an appraisal of the present air conditioning market, Paul Augenstein, President of Chrysler Corporation Airtemp Div, was guest speaker at this Chapter's first meeting of 1960, held January 5th. A cycle of development and change in air conditioning is just beginning, according to the speaker, spurred by intense competition among manufacturers. Needed at this time are controlled planning and a greater sense of the needs of the public.

NORTHEASTERN OKLAHOMA . . . Speaker of the evening Robert L. Fleming of D X Sunray Oil Company presented a talk at the December 21st meeting on the planned propane refrigeration system for the company's de-waxing plant. Purpose of the system is to provide cooling to remove undesirable elements from petroleum products. Used will be a gas turbine-driven three-stage centrifugal compressor capable of producing 1730 ton of refrigeration using a propane refrigerant. Waste heat from the turbine will be recovered to provide low pressure steam for other steps in the process. Speaker Fleming further stated that the equipment would be installed out-of-doors and would be protected by nine safety shut-down devices.

SACRAMENTO VALLEY . . . Problems of burner and boiler selection, boiler output, draft and the effects on these of high altitude were discussed by Neil Wilson, dinner speaker at the December meeting.

Guest lecturer was William Nero of American Air Filter Corporation, who presented a concise talk on the Psychrometric Chart.

CENTRAL ARIZONA . . . As presented by George C. McKhann and Louis R. Jurwitz, speakers at the December meeting, air pollution is a world wide problem, not a local or isolated one. Weather conditions are the effect, but the causes, they contend, are dust, burning of trash, automobile exhaust and manufacturing wastes. Photographs illustrating these conditions were shown and explained.

MONTREAL . . . Explaining, at a recent meeting, the layout of the "Immersion Freezing for Poultry" system was Sig Kuebler, Product Development Engineer at Canadian Ice Machine Company, Ltd. Methods of freezing and effects in color, taste and keeping qualities of the product were highlighted in his talk.

BULLETINS

Thermal Valves. Precision built pilot or control valves specifically designed for installation in gas or liquid systems, these disc-type valves are compact, completely immersible and actuate mechanically, eliminating the need for complex electrical circuits. Four-page Bulletin SP-20 presents principle of operation, features, typical applications and product illustrations.
Texas Instruments Inc., Metals & Controls Div, 34 Forest St., Attleboro, Mass.

Roof Ventilators. A streamlined version of other models in this line of power ventilators, the CKV Statick Low Profile unit described in Flyer 59SP was designed to accord with the low-skyline building trend. Product illustration and dimensions are given.
Hirschman-Pohle Company, Inc., Le-Roy, N. Y.

Switches and Terminals. Comprehensive data on multi-circuit push-button and stack switches has been added to the information on range-heater, motor-reversing, toggle and slide switches contained in 24-page Catalog 1059-FI. Details of handles, hardware, shaft styles and terminals are given, including dimension drawings, wiring diagrams, circuit sequences and electrical ratings for each switch listed. Provided in the terminal section is a tabulation of male and female quick-connect terminals, giving dimensions, wire sizes, stripping data, method of attaching to wires and illustrations showing how terminals are furnished for use with high production terminaling machines. Included in this section are a wide variety of adapters, connectors, terminal multipliers and multi-contact stationary terminals; suggestions are given for designing terminal boards and automatic equipment for high-speed terminaling is shown.
Ark-Les Switch Corporation, 51 Water St., Watertown 72, Mass.

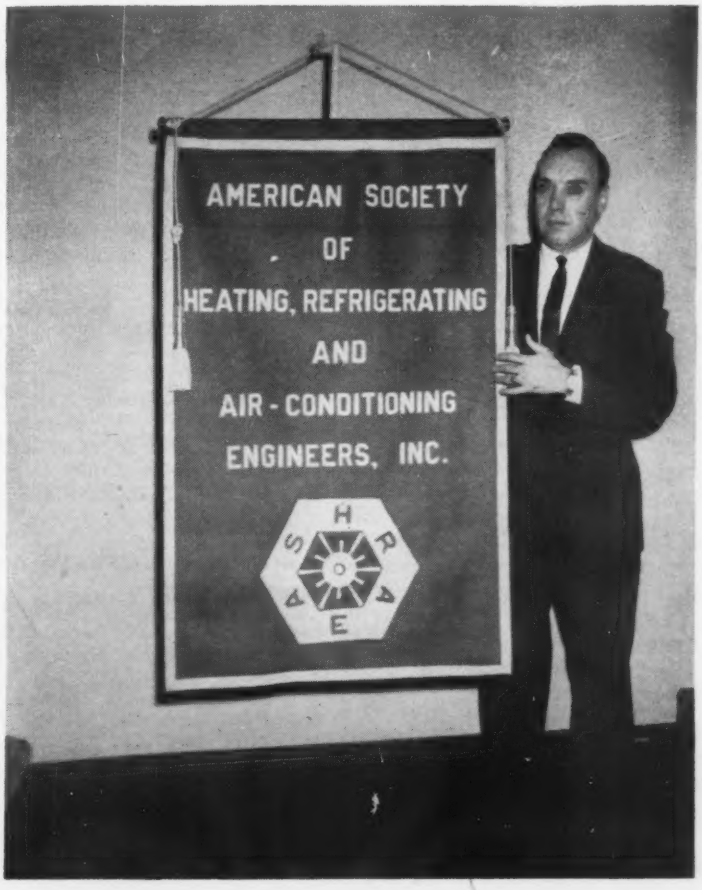
Silencer Unit Selection. Introduction of the short form is cited as enabling engineers and contractors to quickly and accurately determine the type and number of silencing units required for any air handling system. Consisting of a binder and pad of 25 reproducible work sheets, the short form is available at a charge of $1.00.
Industrial Acoustics Company, Inc., 341 Jackson Ave., New York 54, New York.

Cold Storage and Refrigerator Doors. Of a lightweight plastics material, the reach-in and walk-in doors described in four-page Bulletin 5596 are cited as being easier to open and close than wood or metal clad doors and as minimizing fatigue of employees working in and out of cold storage areas. Detailed illustrations and construction drawings are included in the bulletin.
Jamison Cold Storage Door Company, Hagerstown, Md.

Heating and Cooling Products. Registers, grilles, diffusers and furnace accessories are the main subjects of Catalog C. Illustrated and described are side wall, floor, baseboard strip type and out-of-wall diffusers and intakes for perimeter heating and air conditioning; several types of side-wall and baseboard registers and frames for other residential installations; registers and grilles for commercial applications which provide complete flexibility and control of air stream; ceiling diffusers, gravity type registers and returns. Complete technical data is included. Comprising the line of furnace accessories described are furnace and damper regulator sets, damper clips and tips, furnace chain, pulleys, casing clips and hooks.
Hart & Cooley Manufacturing Company, Holland, Mich.

AN ASHRAE BANNER FOR EACH CHAPTER

First of the newly designed Chapter banners reached ASHRAE headquarters just as this issue of the JOURNAL was going to press. Here is Assistant Secretary (Membership) F. W. Hofmann with the banner which closely resembles the master banner of the Society that will be used for National Meetings. Your Chapter will want one of these. Assistant Secretary Hofmann will be pleased to advise as to how this may be arranged.



Candidates for ASHRAE Membership

Following is a list of 144 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before February 29, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note:
* Advancement † Reinstatement

REGION I

Connecticut

CROWDIS, C. C., Pres., Charles C. Crowdis, Inc., Newington.

Massachusetts

CASEY, M. D., Resident Engr., Bogert & Childs, Westfield.

PESEK, V. G., Design Engr., Fraser Engineering Co. Inc., Newton.

New Jersey

BURNICK, ERNEST, Mfg. Repr., Hydrotherm, Inc., Lakewood.

MALONE, W. S., Sales Engr., John J. Nesbitt, Inc., East Orange.

METZGER, I. L., Designer, Indoor Comfort Control Co. Inc., Perth Amboy.

PEPAS, J. J., Engr., Esso Standard Oil Co., Linden.

New York

GOLEMO, JOHN, Layout Draftsman, Carrier Corporation, Syracuse.

GOODMAN, H. D., Htg. Vtg. A-C Engr., Meyer, Strong & Jones, New York.

KINKEL, E. G., JR., Asst. to Pres., Canlake Petroleum Corp., No. Tonawanda.

LIEB, H. Z., Mech. Engr., Berkley Heating Corp., Brooklyn.

ROHM, W. L., Tech. Field Engr., Wagner Electric Corp., Syracuse.

SALANSKY, A. F., Proj. Engr., Carrier Corp., Syracuse.

TRAUTMAN, W. R., Partner, Schlenker, Trautman & Assoc., Buffalo.

TURNBULL, W. A., Engr. & Sales, N.Y.S. Electric & Gas, Binghamton.

Rhode Island

SILVERMAN, EDWARD, Sales Engr., Providence Sheet Metal Co., Providence.

REGION II

Canada

BASTIEN, GERARD, Vice-Pres., J. A. Y. Bouchard Inc., Quebec.

BOULAY, JEAN-PAUL,* Cons. Engr., Ste Foy, Quebec.

BISHOP, C. M., Engr., DeLeuw Cather & Co. of Canada Ltd., Toronto, Ont.

BOURASSA, G. C., Design Engr., Power Corp., Montreal, Quebec.

BROWN, D. B., Br. Mgr., Johnson Controls, Hamilton, Ont.

DESLAURIERS, R. C., Tech. Officer, 4602nd Support Wing (ADC), U.S. Air Force, Ottawa, Ont.

FAHEY, R. J., Repr., S. A. Armstrong Ltd., Toronto, Ont.

FOIRET, F. J.,† Editor, National Business Publications Ltd., Gardenvale, Quebec.

FRANCIS, H. A., Treas., H. G. Francis & Sons Ltd., Ottawa, Ont.

JOBIDON, LAURENT, Sales Repr., Trane Co. of Canada, Quebec.

JONES, M. R., Mgr., Trane Company of Canada Ltd., Saskatoon, Sask.

KING, H. M., Prod. Mgr., Trane Company of Canada, Toronto, Ont.

LAGANIERE, F., Engr., J. A. Y. Bouchard Inc., Quebec.

L'ANGLAIS, FRANCOIS,* Cons. Engr., G. Sarault, Quebec.

MAILLETTE, ORIGENE, Cons. Engr., Department de La Sante, Quebec.

MASSE, YVES, Sales Engr., Honeywell Controls Ltd., Quebec.

MITCHELL, D. J., Sales Repr., Moore & Barran Ltd., Toronto, Ont.

PAQUET, MAURICE,* Cons. Engr., Quebec.

RAY, M. J., Sales Engr., Armstrong Contracting Canada Ltd., Calgary, Alta.

STARR, W. W., Br. Mgr., Carrier Engineering Ltd., St. Boniface, Manitoba.

TATTLE, J. A., Jr. Engr., O. C. Moffat, Ltd., Hamilton, Ont.

TAYLOR, ALLAN, Engrg. Dept. Mgr., Hamilton Plumbing & Heating Supplies, Hamilton, Ont.

TONI, HENRY, Sales Engr., Roberts-Gordon Appliance Corp., Grimsby, Ont.

TURCOTTE, G. S.,* Design Engr., Gilles Sarault, Quebec City, Que.

UNGER, H. B., Design Draftsman, Crowther, MacKav & Assocs. Ltd., Winnipeg, Manitoba.

VEILLEUX, JEAN,* Cons. Engr., J. L. Beaudet Inc., Quebec.

REGION III

District of Columbia

LEWIS, J. O., Sales Engr. Supvsr., Minneapolis - Honeywell Regulator Co., Washington.

Pennsylvania

DOUGHERTY, F. R., Designer, Lukens Steel Co., Coatsville.

GOLDSTEIN, E. F., Tech. Dir., ARC Company, Philadelphia.

HAINES, H. A.,† Htg. Engr., Lehigh Valley Supply Co., Allentown.

HUNTER, W. W., Engr., Dravo Corp., Pittsburgh.

KIEFER, E. J.,* Mech. Engr., Rinker & Kiefer, Stroudsburg.

MESSINA, M. P., Sales Engr., Dunham-Bush Inc., Jenkintown.

VORBECK, J. C.,† Sales Engr., Marlo Coil Co., Drexel Hill.

ZELLNER, F. J.,* Sales Engrg. Supvsr., Minneapolis - Honeywell Regulator Co., Philadelphia.

Virginia

ROACHE, M. O. JR., Partner, Roache & Mercer, Richmond.

West Virginia

HENDLEY, S. G., Vice-Pres., H. T. Boggs Co. Inc., Huntington.

REGION IV

Florida

RICH, JOE, Pres., Miami Beach Refrigeration Inc., Miami Beach.

Georgia

HANKINSON, W. B., Draftsman, Carrier Corp., Atlanta.

JERNIGAN, J. K., Appl. Engr., Westinghouse Electric Corp., Atlanta.

PRICE, F. E., Sales Engr., F. J. Evans Engineering Co., Atlanta.

REGION V

Ohio

BREISCH, R. L., JR., Tech Repr., Airtemp Division, Chrysler, Dayton.

KAMANTAS, VYTAUTAS, Proj. Engr., Avery Engineering Co., Cleveland.

KIRKWOOD, R. J., Asst. Sales Mgr., North American Mfg. Co., Cleveland.

LINVILLE, J. R., Proj. Engr., Janitrol Div., Midland-Ross Corp., Columbus.

PARKER, J. A., Sales Engr., Minneapolis-Honeywell Regulator Co., Dayton.

REYNOLDS, R. J., Appl. Engr., York Corp., Cleveland.

ROBINSON, J. W., Sales Engr., Musson Equipment Co., Cleveland.

SIMPSON, J. H., JR., Sales Engr., North American Manufacturing Co., Cleveland.

SMITH, D. C., Engr., Airtemp Division, Chrysler, Dayton.

TAYLOR, SANFORD, JR., Mech. Engr., Rossford Ordnance Depot, Toledo.

REGION VI

Illinois

ALTER, J. M., Exec. Vice-Pres., Harry

Alter Co., Chicago.

BOYAR, R. E., Chief Engr., Burgess-Manning Co., Libertyville.

CAMPIONE, J. L., Supvsg. Engr., Swift & Co., Chicago.

CANNAVAN, E. G., Mgr., Montefusco Heating & Sheet Metal Co., Peoria.

FRANKLIN, T. J., Design Trainee, John Dolio & Assoc., Chicago.

FREELS, R. A., Contract Sales Engr., Powers Regulator Co., Peoria Heights.

WALKER, G. S., Owner, George S. Walker, Inc., Decatur.

WALLIN, M. B., Vice-Pres & Sales Mgr., Himelblau, Byfield & Co. Inc., Chicago.

Michigan

BOLTON, R. H., Partner, Bolton & Helveston, Lansing.

CARMICHAEL, ARTHUR, JR., Mech. Design Engr., Migdal & Layne, Detroit.

KENYON, F. C., JR., Appliance Market Coordinator, Dow Chemical Co., Midland.

MULLINS, R. T., Laboratory Test Supvsr., Coolerator Co., Albion.

NEAL, J. R., Gen. Mgr., Quincy Products Div., Stubnitz-Greene Corp., Quincy.

WERN, C. R., Mech. Engr., Dolgner, Rollason & Rokicki, Detroit.

WOLF, M. A., Engr., F I A T—Fahlrica Italiana Automobils Torino-Italy, Detroit.

Minnesota

MILLER, R. E.,† Mgr., American Radiator & Standard Sanitary Corp., Minneapolis.

RIBAR, L. E., Partner, Ribar-Johnson Inc., St. Paul.

SUKALO, JOHN, Exec. Vice-Pres., Thermal Company Inc., St. Paul.

Wisconsin

HAUSER, P. P., Sales Appl. Engr., Vilter Mfg. Co., Milwaukee.

LONN, H. J.,† Proj. Engr., General Controls Co., Milwaukee.

MEYER, M. L., Sr. Testing Engr., Johnson Service Co., Milwaukee.

REGION VII

Indiana

FREIJE, W. F. JR.,* Vice-Pres., Wm. F. Freije Inc., Indianapolis.

Kentucky

PINCKLEY, M. E., Field Engr., Griffin & Company, Louisville.

Louisiana

RIORDA, J. S., Dealer Repr. in Gen. Sales Dept., New Orleans Public Sales Dept., New Orleans.

WILSON, G. E., JR.,* Sales Engr., Airco Refrigerating Service Inc., New Orleans.

Mississippi

PETERS, J. M., Utilization Engr., United Gas Corp., Gulfport.

Missouri

COUSINS, DON.,* Mgr. Merchandising Sales, Marley Co., Kansas City.

HASTIE, D. T., Sales Repr., American Radiator & Standard Sanitary Corp., St. Louis.

SPOEHRER, F. H., Sales Trainee, Sporlan Valve Co., Maplewood.

WEIR, P. H., Sales Engr., Sporlan Valve Co., St. Louis.

Tennessee

BOUDOLF, H. A.,* Sales Engr., Dunham-Bush Inc., Memphis.

REGION VIII

Arkansas

DIGGS, E. P., Constr. Supt., Fagan Air Conditioning Co., Little Rock.

DOSSETT, O. D., Archt. & Engr. Advisor, Arkansas Power & Light Co., Little Rock.

Louisiana

JORDAN, J. C., JR., Mech. Engr., Neild-Somdal - Smitherman & Assocs., Shreveport.

Oklahoma

HOLLOWAY, W. B., Sales Engr., J. P. Ashcraft Co. Inc., Tulsa.

JOHNSTON, B. G., A-C. & Htg. Sales Engr., Oklahoma Natural Gas Co., Tulsa.

MULLINS, G. D., Dist. Mgr., Arkla Air Conditioning Corp., Tulsa.

STRAIN, W. R., Sr. Sales Engr., Minneapolis-Honeywell Regulator Co., Tulsa.

Texas

HERRING, E. W., Engr., United Gas Corp., Houston.

LEONARD, P. E., Mech. Engr., Wyatt C. Hedrick, Dallas.

MCGONAGLE, M. L., JR., Secy. & Asst. Treas., Thermal Engineering Corp., Houston.

PEARD, R. A.,* Sales Engr., York Corp., Houston.

WAHLERS, H. F., JR., Sales Engr., L. E. Minns & Co., Inc., Houston.

REGION IX

Colorado

SMITH, A. S., Gen. Bldg. Engr., Mountain States Tel. & Tel. Co., Denver.

Nebraska

MCCORMICK, W. J., Mech. Engr., Government (Air Force Region at C/E Office) Omaha.

New Mexico

SMITH, W. C., Owner, Alaskan Air Conditioning Co., Albuquerque.

REGION X

Arizona

DUREE, A. W., Mech. Engr., Salt River Power District, Phoenix.

British Columbia

DEVOUS, E. C., Repr., Armstrong Contracting Canada Ltd., Vancouver.

California

CHAMBERS, K. M., Design Engr., North American Aviation, Downey.

DAWSON, J. L., Appl. Engr., Richard S. Dawson Co., Los Angeles.

KENNEDY, MARON.,* Sales Engr., York Corp., Los Angeles.

VON GOTTBERG, W. W., Gen. Foreman & Estimator, Fred F. Antelline, Inc., San Diego.

Oregon

WILLIAMS, J. F., Asst. Sales Mgr., Far Western Equipment & Chemical Co., Portland.

Canal Zone

HOVERSON, J. A., Gen. Foreman, Panama Canal Co., Mt. Hope.

FOREIGN

Arabia

FAKHOURY, ABDELRAHEM, Trainee, Carrier Corp., Kuwait.

Italy

MOZZI, GIANMARIO, Prof., Scvola del freddo, Pisa.

SCUDELETTI, UMBERTO, Owner, Scudeletti & Co., Milan.

Singapore

WU, PHILIP, Engr., International Air Conditioning Co., Alexandra.

Sweden

GORANSSON, ERIK, Engr., Varme och Sanitetstekniska Byran AB, Stockholm.

Switzerland

WIRTHENSOHN, WALTER, Engr., Engineering Bureau, Luzern.

Venezuela

GUTTER, F. T., Design & Field Engr., S.A.V.E.R. Guinand Dep. Carrier, Caracas.

West Indies

LYON-HALL, R. C.,* Owner & Designer, Robert C. Lyon-Hall & Assoc., Jamaica.

STUDENTS

ALOI, J. L., NYS Agricultural-Technical Inst.-Alfred Univ., Alfred, N. Y.

BOEHME, M. L., Oregon State College, Corvallis, Oregon.

BOWER, F. C., Oregon State College, Corvallis, Oregon.

BROWN, G. P., Oregon State College, Corvallis, Oregon.

BUCE, T. A., Oregon State College, Corvallis, Oregon.

ELDRIDGE, R. E., Oregon State College, Corvallis, Oregon.

GIVENS, L. H., Oregon State College, Corvallis, Oregon.

HART, R. R., Oregon State College, Corvallis, Oregon.

JORGENSEN, R. W., University of Minnesota, Minneapolis, Minn.

KELLY, J. D., Oregon State College, Corvallis, Oregon.

MCHENRY, D. W., Oregon State College, Corvallis, Oregon.

SINCLAIR, R. L., Oregon State College, Corvallis, Oregon.

TURNER, D. B., Oregon State College, Corvallis, Oregon.

UCHIDA, G. S., Oregon State College, Corvallis, Oregon.

WALL, K. J., Oregon State College, Corvallis, Oregon.

Functions and responsibilities of the Technical Division

As chairman of the ASHRAE Research and Technical Committee, Dr. Richard C. Jordan has made two reports to the Society membership in the JOURNAL (May 1959 and January 1960). These have related the structure and overall objectives and responsibilities of the various segments of the Research and Technical Committee organization which consists of a Research Division and a Technical Division. It is my purpose to amplify somewhat upon the function and responsibility of the latter.

First, the Research Division of the Research and Technical Committee has the difficult and time-consuming job of administering the research program of the Society. This it will carry out with the assistance, advice and recommendations of the six Research Advisory Committees (RAC's) and a number of specially-appointed task groups called Research Panels (RP's). The Technical Division of the R and T Committee, while it has no direct responsibility for the research program, has important lines of communication with this program. First, the Technical Division reports to the R and T Committee through the Committee's Vice Chairman. Second, the Operational Guide of the R and T Committee requires that at least one member of each Research Panel appointed must be chosen from a cognizant or interested Technical Committee. Since Research Panels will normally be formed to review research program results, recommend new paths of investigation or qualify proposed programs, there will always be Technical Division influence in these areas.

Aside from the influence that the Technical Division organization may have on the Society's research programs, it has a number of direct responsibilities. In order to place these in their proper perspective, let us observe the methods, other than research, used by the Society to carry out its objective "to advance the arts and sciences ——————." These are: its meetings, the technical papers presented to it, the published record of this activity as found in the JOURNAL and TRANSACTIONS, the basic or handbook data of its sphere of technology as found in THE GUIDE AND DATA BOOK and in its Standards. The Technical Division, through its Technical Committees (TC's) is expected to make contributions in all these areas.

Two points of view can be taken with respect to TC activities. There are those that hold that a TC must justify itself through some active work assignment, and certainly it must over the long term. Alternatively, one can consider the Technical Division organization as the distilled "brains" of the Society, a reservoir of classified technical knowledge or simply the sum total of Society membership who are currently capable, willing and able to devote a part of their professional energies to joint technical activities. I prefer this latter concept. However, it must be recognized that some TC activity will be assigned work, some will be self-generated. Examples of both types are:

Assigned Tasks

1. Review and preparation of material for THE GUIDE AND DATA BOOK. This is probably one of the most important functions of the TC's. Assignments will come from other committees such as Publications or Guide and will be handled through TC Coordinators. Such assignments may involve individual TC's or may, at times, involve most of the TC organization.
2. Review technical papers submitted for presentation to the Society. The Program Committee, through the Technical Secretary, or directly, can refer such material to a TC or individuals in a TC if it should desire comment or recommendations. The cognizant TC Chairman and Group Coordinator should always be kept advised.
3. Prepare replies or recommend a course of action on questions referred to the Society by individuals, government agencies, other organizations, etc. Depending upon the nature of the question, such assignments may come from Headquarters or from the Research and Technical Committee organization. The Chairman and Vice Chairman of R and T Committee and cognizant Coordinator will be kept advised of such matters.
4. Prepare recommendations on subjects relating to the Society's research program. Such assignments will, of course, come through the Coordinator from the R and T Committee Chairman or Vice Chairman. This may be done in cases which do not justify the appointment of a special Research Panel to study the matter.
5. Study and make recommendations concerning the need for a change or changes in Standards or Research Bulletins. Such assignments may be made through channels by the Standards Committee or by R and T Committee Chairman. It should be pointed out that TC's are not expected to engage directly in the preparation of such material.

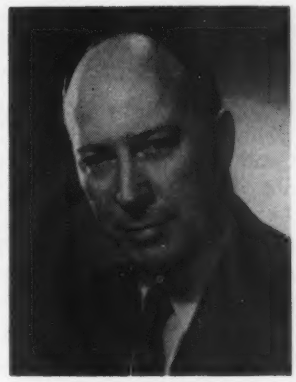
Self-Generated Activity

1. TC's should continually have the content of the Society's published material under surveillance and should recommend programs for improve-

of the ASHRAE Research and Technical Committee

E. P. PALMATIER

Vice Chairman
ASHRAE
Research and Technical
Committee



ment as new technical material becomes available.

2. Where voids or limitations exist in published data, TC's may conduct a preliminary study of the situation and formulate appropriate recommendations to the R and T Committee.
3. Subject to approval of the Program Committee, TC may initiate and conduct forums and open discussion at regular Society meetings in cases where an airing of a particular technical subject would appear to be in the public interest.

All of the above activities have been carried out successfully in the past by the TC's of the ASRE and the TAC's of ASHAE.

As to the Technical Committee organization structure. This, obviously, is patterned after the former ASRE Technical Committee. The number of groups was increased from six to eight to accommodate the broader scope of the merged Society and make a more logical classification of its technology. In the interest of retaining all active personnel, it will be noted that, in some cases, former ASHAE TAC's and ASRE TC's have been integrated.

Group 1.0 Basic Theory and Materials

- 1.1 Combines former ASRE TC 1.1 Heat Transfer and Fluid Flow with TC 3.7 on Fixed Restrictor Devices.
- 1.5 Is a new TC formed from membership of the former ASHAE TAC on Weather Data.
- 1.6 Is a new TC formed from a part of the membership of the former ASHAE TAC on Combustion.
- 1.7 Is a new TC formed from membership of the former ASHAE TAC on Solar Energy Utilization.
- 1.8 Is former ASRE TC 3.5 relocated from Group 1.0.
- 1.11 Is constituted by merging the membership of former ASRE TC 1.7 Thermal Insulation and Vapor Barriers and ASHAE TAC on Insulation.
- 1.13 Is a new TC formed from membership of the former ASHAE TAC on Sorption.

The remaining TC's in Group 1.0 are carried over from the ASRE Group 1.0 structure with slight changes of title in a few cases. Former ASRE TC 1.4 has been relocated under Group 6.0.

Group 2.0 Basic Equipment

The new TC's 2.1 to 2.6 inclusive are derived directly from the former ASRE TC's with a few modifications of title. TC 2.7 merges personnel from former ASRE TC 6.7 and former ASHAE TAC on Air Distribution. 2.8 is a new TC formed from the membership of the former ASHAE TAC on Air Cleaning.

Group 3.0 Auxiliary Equipment

TC 3.1 will be formed by merging former ASRE TC 3.1 with a portion of the former ASHAE TAC on Control. TC's 3.2 and 3.3 remain as in the former ASRE structure. Former ASRE TC's 3.4 and 3.5 have been relocated under Groups 6.0 and 1.0 respectively. The new TC 3.4 is the same as former TC 3.6.

Group 4.0 Systems

TC's 4.1, 4.2 and 4.3 are former ASRE TC's 6.2, 6.4 and 6.5. Former ASRE TC's 6.1 and 6.3 have been reassigned to Group 8.0. TC 4.4 is former TC 2.7 reassigned. TC 4.5 is a new committee staffed by a portion of the membership of the former ASHAE TAC on Hot Water and Steam Heating. Former TC's 6.6 and 6.7 have been reassigned to Groups 5.0 and 2.0 respectively.

Group 5.0 Heating and Refrigeration Loads

The new TC 5.1 is formed from the former TC 6.6. Consideration is being given to the addition of a portion of the personnel of the TAC on Heat Pump to this TC. TC 5.2 is a new TC formed from a part of the membership of the former ASHAE TAC on Thermal Circuits. 5.3 is a new TC formed from a part of the membership of the former RAC on Energy Transfer through Fenestration.

Group 6.0 Environmental Control and Effects

TC 6.1 is former TC 1.4 reassigned to Group 6.0. Similarly, TC 6.2 is former TC 3.4. 6.3 is a new TC formed from a part of the membership of the former TAC on Odors. 6.4 is similarly derived from the former ASHAE TAC on Industrial Environment.

Group 7.0 Unitary Equipment

This entire group is identical to former Group 4.0 of the ASRE Technical Committee, i.e., TC 4.1 becomes 7.1, TC 4.2 becomes 7.2, etc.

Group 8.0 Products and Processes

This group has been formed from the former ASRE Group 5.0 with TC's 8.1 to 8.6 corresponding to TC's 5.1 to 5.6 inclusive. Two additional committees have been relocated. Former ASRE TC 6.3

(*Continued on page* 88)

Meetings ahead

February 1-4 – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Semiannual Meeting, Dallas, Tex.

February 1-4–2nd Southwest Heating and Air-Conditioning Exposition, Dallas, Tex.

March 6-10 – National Association of Frozen Food Packers, 19th Annual Meeting, Chicago, Ill.

March 21-23–First National Electric House Heating Exposition, National Electrical Manufacturers Association, Electric House Heating Equipment Sect, Chicago, Ill.

March 29-31 – American Power Conference, 22nd Annual Meeting, Chicago, Ill.

March 30 - April 1 – Gas Appliance Manufacturers Association, Annual Meeting, White Sulphur Springs, W. Va.

April 4-7 – Oil Heat Institute of America, Annual Convention, New York, N. Y.

April 4-7–Oil Heat Institute of America, 23rd National Oil Heat and Air Conditioning Exposition, New York, N. Y.

April 5-7 – Building Research Institute, Spring Conferences, New York, N. Y.

April 27-30 – 3rd Western Air-Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Los Angeles, Calif.

May 19-21 – Refrigeration Research Foundation, Annual Meeting, Denver, Col.

May 22-25–Industrial Heating Equipment Association, Hot Springs, Va.

May 22-26 – National Association of Refrigerated Warehouses, Annual Meeting, Denver, Col.

June 6-9–Institute of Boiler and Radiator Manufacturers, Annual Meeting, Absecon, N. J.

June 13-15–American Society of Heating, Refrigerating and Air-Conditioning Engineers, 67th Annual Meeting, Vancouver, B. C.

People

Clyde W. Kelly retired on December 31st from Fenestra, Inc., after more than 40 years of service. He was appointed Assistant Chief Engineer in 1928, Chief Engineer in 1952 and Director of Engineering Research in 1957. A member of ASHRAE, Illuminating Engineering Society, American Society for Testing Materials, National Society of Professional Engineers and Building Research Institute, he was Chairman of the Technical Committee of the Steel Window Institute for several years. He will continue as a Mechanical Design Consultant.

James F. Sasser advances from his former position of Manager of Limbach Company's Mechanical Dept to Staff Manager of the Mechanical Div. After graduation from Purdue University with a degree in mechanical and electrical engineering, he entered the air conditioning and mechanical construction field, supervising such heating, ventilating and air conditioning projects as the H. K. Porter Building, State Office Building and St. Francis Hospital Rehabilitation Institute, all located in Pittsburgh.

James M. Huff, a partner in Seebree-Huff Equipment Company, has joined the staff of Biddle and Young, Consulting Engineers.

Harold McDonald of Mathes Company has been elected Vice President in Charge of Manufacturing, a post created recently as part of an over-all corporate plan providing for future company growth. In this position, he will supervise all manufacturing for the organization, which makes residential and commercial air conditioners and heat pumps. Joining Mathes in 1954 as Tool and Die Shop Foreman, he was subsequently promoted to Tool Design Engineer, Plant Manager and Director of Manufacturing.

N. Bert Persson, a food facilities consultant since 1939 when he started his own company under the name Food Service Equipment Engineering, has been appointed Vice President of Food Service Engineering Corporation. Prior to the organization of his own business, he had been for twelve years Chief Engineer for a food service equipment manufacturer. In addition to ASHRAE, he holds membership in the Minnesota Association of Consulting Engineers.

Lester E. Cover, retired Research and Industrial Engineer of Armstrong Cork Company, died on December 18, 1959. With Armstrong for 41 years, he retired in 1957, joining Owens-Corning Fiberglas Corporation to assist in research. While associated with Armstrong he organized plant laboratories for the company, among them the Argo Research Laboratory at Closter, N. J. A pioneer in the field of industrial insulation, he helped to develop fibre board.

R. A. Baker, Manager of the Syracuse office of Minneapolis-Honeywell for the past 15 years, has been appointed to a new post in the San Francisco office, which he will assume early in March. Active in ASHRAE affairs, he was Chairman of the First Annual Meeting at Lake Placid last June, serving concurrently as Region I Director. During the 1951-52 season he was Chairman of ASRE's Central New York Section.

E. Peter Sorensen of Airo Supply Company, Inc., was elected Vice President of the Air Conditioning and Refrigeration Wholesalers Association at the Annual Meeting held in Atlantic City on November 1 and 2. Other ASHRAE members elected to office were **E. H. Davey** as Secretary and **Paul Bodwell, Jr.,** as Treasurer.

Leonard Greenburg, who resigned as Commissioner of the New York City Dept of Air Pollution Control on January 8th after having served in that capacity since the establishment of the dept in 1952, will be Professor and Acting Chairman of the Dept of Preventive Medicine at the Albert Einstein College of Medicine. Holder of a Civil Engineering degree from Columbia University, a doctorate in public health and a Doctor of Medicine degree from Yale University, Dr. Greenburg has published more than 100 technical papers in the fields of public health, industrial hygiene, industrial medicine, safety and air pollution and its control. Currently President of the Air Pollution Control Association, he is a member of the American Medical Association, New York Academy of Medicine, American Association for the Advancement of Science, American Public Health Association, American Conference of Governmental Industrial Hygienists and ASHRAE, among others.

Harold P. Mueller, Jr., Executive Vice President of Mueller Climatrol Div of Worthington Corporation, has been named Second Vice President of National Warm Air Heating and Air Conditioning Association. He was completing his first year as a Trustee of the Association at the time of his election.

James W. Hosler, a mechanical engineering graduate of the University of Illinois, has been appointed General Sales Manager of American-Standard's Industrial Div. With the organization since 1947, he has served successively as Chicago District Merchandise Supervisor, Application Engineer, Merchandise Dept Product Manager, Commercial Air Conditioning Dept Manager and Marketing Manager for air conditioning products. Earlier this year he was promoted to Marketing Manager for Kewanee and Nesbitt product lines, a position he held at the time of his new appointment.

Sidney Shapiro has been promoted to Vice President of Tenney Engineering, Inc., as head of the company's expanded heat transfer components div. Joining Tenney in 1945 to work on all phases of coil production and assembly, he later joined the sales department and became Sales Manager .

Royal S. Buchanan, with Westinghouse Electric Corporation since his graduation from the University of Illinois in 1930, becomes Assistant Director, Engineering and Research, Appliances Div, American Motors Corporation. Previously, he has been Field Service Supervisor, Design Engineer and Engineering Section Manager with Westinghouse. In addition to ASHRAE, he holds membership in the Society of the Plastics Industry.

Kenneth C. Mirov has been promoted to Manager of Trane Company's San Francisco office, moving up from his previous position as Assistant Manager. Joining Trane in 1947 after his graduation from the University of California, he completed a specialized course in air conditioning and heating for graduate engineers at the company's home office before going to San Francisco.

William Felderman, President, Chairman of the Board and Founder of Walton Laboratories, Inc., and President and Chairman of the Board of Bruce Metal Products, Inc., died on November 13th. Born and educated in Plymouth, England, he is best known for pioneering and development of humidifiers for all applications of humidity control.

John L. Roth, formerly Sales Manager of associate sales for York Corporation, is now Product Manager, Air Conditioning. Prior to joining York, he was Sales Manager of the refrigeration machinery div of General Electric Company in Bloomfield, N. J. Associated with the air conditioning and refrigeration industry in various capacities for more than 20 years, he is a member of ASHRAE, American Management Association, National Sales Executives Club, American Military Engineers Society and the National Home Builders Association.

R. H. Meyerhans, Director of Engineering of Fedders Corporation, has been named Chairman of Nema's Room Air-Conditioner Sect General Engineering Committee.

Others are saying—

that . . . . . . thermal equivalence, determined by moving from one environment to another, is actually the result of tests made with the human body on the relative values of evaporation and of convection. Its practical use, the author contends, is limited, for the laws of evaporation from a wet, inert body are derived when near the limit of body temperature regulation. In heating and ventilating practice where room temperatures do not exceed 71 to 76 F, the dry resultant temperature is cited as being the only concept of real value, but above this temperature the humidity effect becomes important, and increases in importance with rise of temperature. *Journal of the Institution of Heating and Ventilating Engineers, November 1959, p 231 (British).*

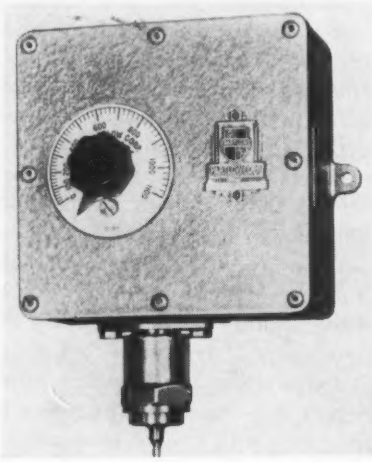
that . . . . . . in determining the most efficient method of utilizing natural gas for an air conditioning system, investigation showed that an effective means was to combine an internal combustion engine with a vapor compression cycle. The free-piston configuration was selected for this combination because its inherent simplicity made possible low initial cost with the quality required for long service life. *Mechanical Engineering, December 1959, p 57.*

that . . . . . . while performing the same functions as other well- developed mechanical systems in the production of heat or cold, thermocouples have these distinct advantages: absence of moving parts to wear out or cause noise; small size, making practicable the building of generators or heat pumps of almost any desired size; direction of heat flow and direction of current flow are directly related, reversing one will also reverse the other which makes summer-winter changeover of equipment possible by turning a switch. Improvement in efficiency would, the author contends, greatly increase the applications of thermoelectricity. *Journal of the American Society of Naval Engineers, Inc., November 1959, p 657.*

PARTS AND PRODUCTS

TEMPERATURE CONTROL

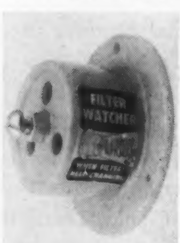
Designed primarily for exterior use to control either refrigeration or heating equipment, the single-point, weather-resistant, non-indicating temperature



control shown, Model GWS, is supplied with a manual reset limit switch, which acts as a limit control to shut off a heating or cooling medium at any predetermined temperature. Reversing the position of the switches permits the instrument to operate with equal efficiency for either heating or cooling.
Partlow Corporation, 530 Campion Rd., New Hartford, N. Y.

FILTER SIGNAL

For automatic alarm when filters on air conditioning, air handling or forced warm air heating systems need changing or cleaning, this signal may be installed on the blower enclosure between the filters and the blower. As the filters become dirty and clogged, the blower sucks air through the whistle, which gradually builds up an audible whistling alarm signal.



Viking Instruments, Inc., East Haddam, Conn.

AIR HANDLING UNITS

Rated from 800 to 34,000 cfm for direct expansion, chilled water, hot water and steam, these compact, modular design units for air conditioning, ventilating or heating feature blower section independent from coil sections; top, bottom or rear fan discharge; and various combinations of coils and accessories.

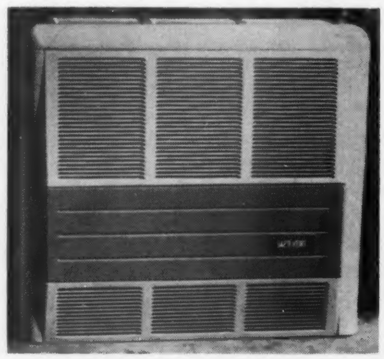
Standard wheels on the AH units are Class I construction taking up to 3½-in. of static pressure. Class II construction for units rated at 7000 cfm and higher is with backward-curved wheels for up to 6 in. of static pressure.
Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.

URETHANE FOAMS

With this company's formulations, which are based on modified castor oil derivatives, low density foams (1.5 to 2.0 lb/cu ft) exhibiting no after-shrinkage can be sprayed, without sagging, on vertical surfaces in any thickness desired. Simplicity of the method makes it useful for applying foam as insulation on or between walls, tank or pipe exteriors, as void filler and as protective coating for electrical equipment.
Baker Castor Oil Company, 40 Ave. A, Bayonne, N. J.

SEALED GAS HEATER

Heating independently from the home heating plant, burning either city or bottled gas, thermostatically controlled and able to be installed by venting through an outside wall, the Safti-



Vent gas heater eliminates chimneys and duct work, providing heat for isolated locations such as garages.
H. C. Little Burner Company, Inc., Dubois and Woodland, San Rafael, Calif.

1960 REFRIGERATORS AND FREEZERS

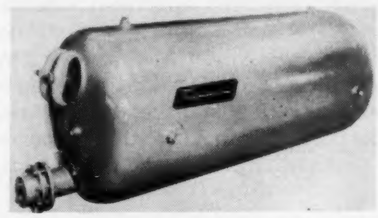
Use of a new type of insulation is cited as providing approximately 15% greater food storage capacity in refrigerators and an extra 1.6 to 3.1 cu ft in freezer units, while models occupy the same floor space as those of the 1959 line. Used is a high density, expandable spun glass insulating material, having a tighter weave than other insulations.

Ten models are included in the refrigerator line, ranging from 9.6 to 16.5 cu ft in gross capacity. Frozen food capacity ranges from 38 to 178½ lb. Three models in the line are conventional refrigerators, one is automatic defrosting, while the remaining six units are no-defrosting Dual Temp refrigerator-freezers.

New freezers in the line are available in three horizontal models of 12, 17 and 23 cu ft gross capacity and six upright units ranging from 9.6 to 18.7 cu ft, all with double grid freezing shelves. Four of the uprights are produced without coils on the back for flush-to-wall installation.
Admiral Corporation, 3800 Cortland St., Chicago 47, Ill.

STORAGE TANKS

Added to the line of water heating equipment offered by this manufacturer is a full line of hot water storage tanks. Featured is full glass lining, made possible through provision of an



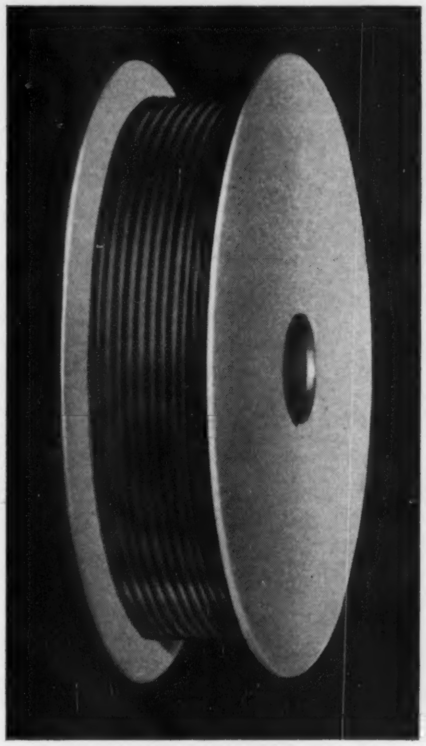
11 x 15 in. access manhole, allowing lining after the ends were welded to the tank.
Raypak Company, 2416 Chico Ave., El Monte, Calif.

GAS CONVERSION BURNER

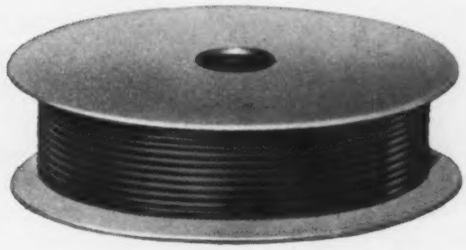
A major feature cited for the Tele-Tube burner is its adjustable venturi, which telescopes from 6½ to 13½ in., to fit most furnace and boiler entrances. Produced principally from 16-gauge stamped and welded steel, the entire unit weighs only 13 lb yet delivers 50,000 to 225,000 Btu. The manufacturer describes the burner as an inshot model with upshot characteristics. Gases are mixed with air, then forced into the furnace horizontally where they are deflected downward at a 17 deg angle.
Barber Manufacturing Company, 1052 E. 134th St., Cleveland 10, Ohio.

NOISE REDUCTION PANEL

For separation and reduction of noise in schools and commercial structures, this panel is cited as having excellent sound absorption qualities and preventing sound transmission to a degree equal to a high grade dry wall partition. Thickness of the panel is 2⅜ in. and the standard size is 4 x 8 ft. It can be cut with conventional carpenter tools and installed by using either wood studs with wood moldings or a steel partition system supplied by the manufacturer.
Elof Hansson, Inc., Acoustical Div, 711 Third Ave., New York 17, N. Y.



Save with WOLVERINE Level-Wound Coils



WOLVERINE LEVEL-WOUND COILS

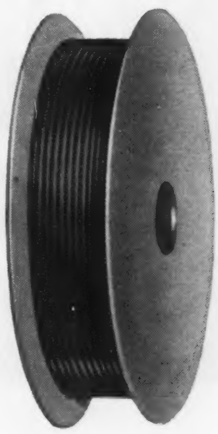
permit tubing to unwind at high speeds without danger of tangling or snarling.

WOLVERINE LEVEL-WOUND COILS

are ideal for feeding automatic equipment — often release operators for other duties.

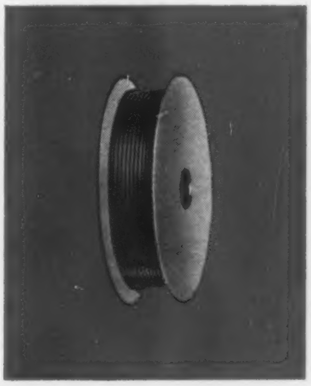
WOLVERINE LEVEL-WOUND COILS

reduce tube handling—save time in assembly line operations.



WOLVERINE LEVEL-WOUND COILS

permit you to stock more tube in less space —help reduce inventory problems.



WOLVERINE LEVEL-WOUND COILS

contain tubing made the Tubemanship-way—quality controlled tubing that is backed by research, years of experience and sound engineering.

Your Wolverine sales representative has the complete story. Why not talk it over with him—let him show you exactly how Wolverine level-wound coils can fit into your manufacturing process to save you time, money and labor. Write, too for your copy of the Wolverine Tubemanship Book.

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17244 Southfield Road
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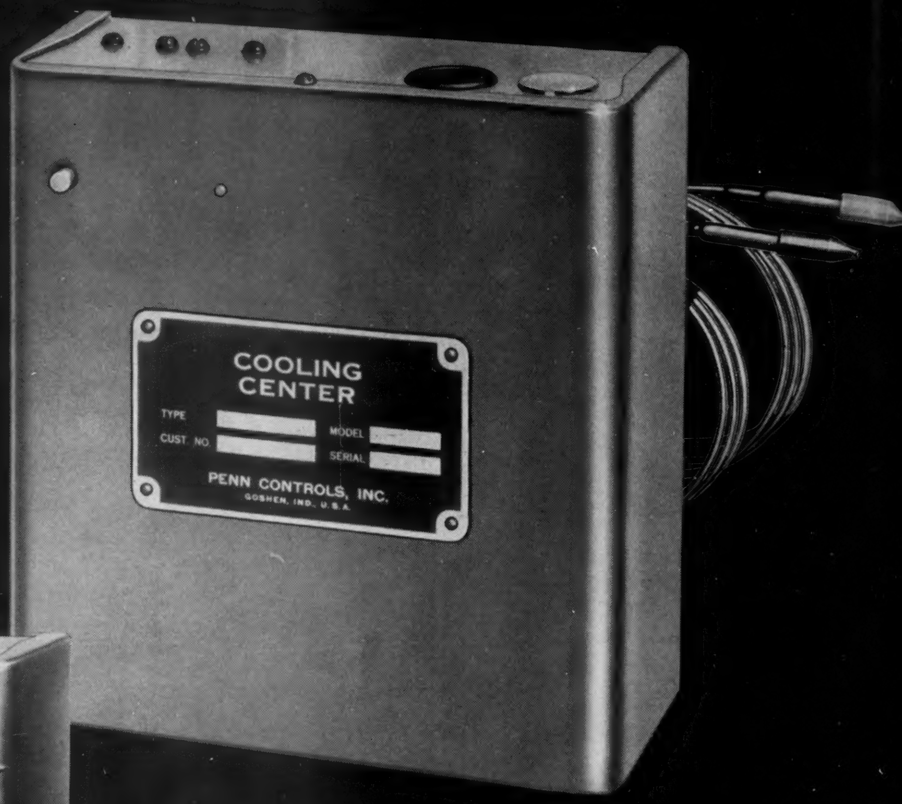
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

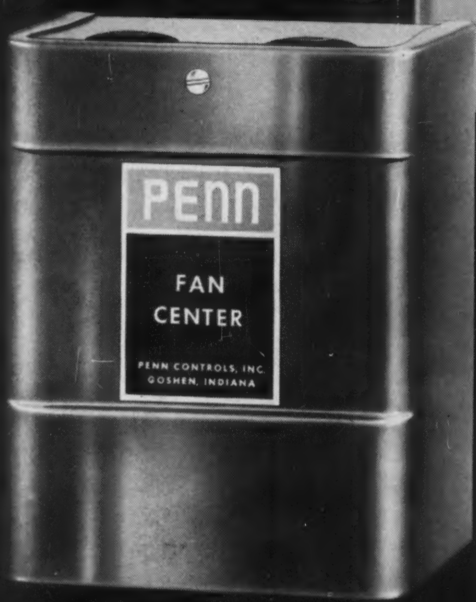
J-8367

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

COOLING CENTER
. . . controls the remote condensing unit. Internal circuits are factory-wired.

FAN CENTER
. . . controls the air handling equipment on all systems with remote condensing units.

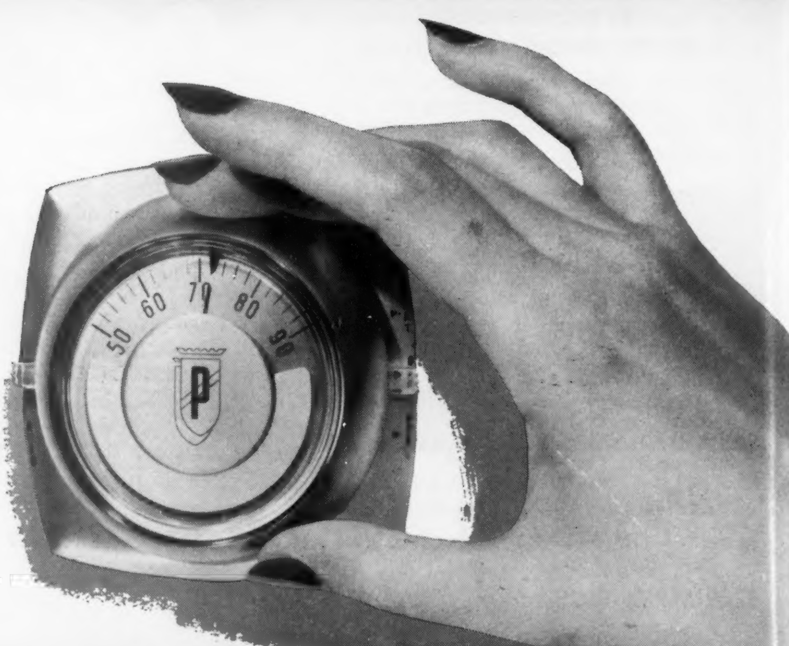


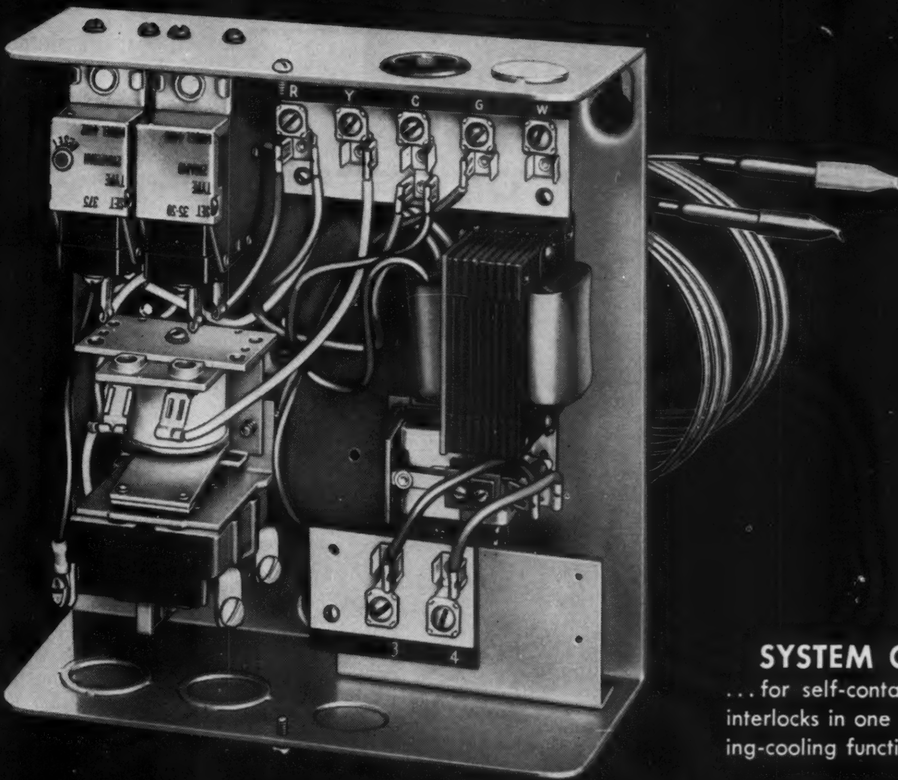


ALL-NEW! A
"CODED" C

RIMSET thermostat ...just dial the rim!

Here's the room thermostat to use on all of your heating-cooling jobs. It is easier to set . . . easier to read . . . simply dial the rim, the scale remains stationary. It is easier to install . . . leveling is not essential. It has snap-acting contacts . . . no "teetering" to cause undesirable "on-off" operation. It has various sub-bases for 12 different heating-cooling jobs. And, it has modern styling and beauty.





SYSTEM CENTER
. . . for self-contained systems interlocks in one unit all heating-cooling functions.

! AIR CONDITIONING
” CONTROL CENTERS

with color coding of all internal wiring!

COLOR CODING is today's biggest, most welcome news in Control Centers for residential air conditioning. It makes servicing . . . when and if required . . . extremely easy and fast! It saves time . . . saves money . . . and avoids system shutdown!

In Penn's newest line of Control Centers, field-replaceable components are easy to get out . . . easy to get in *correctly* because all internal wiring is color coded. And, all color-coded leads are equipped with *quick-connect terminals* . . . no more looping of wire or soldering connections.

There are other advantages, too! Centers are small to save space in compact 2 and 3 H.P. units, yet they are easily accessible. Wrap-around cases save wiring time in factory and field. And, field-installed Fan Centers have Life Guard reverse panel construction. All operating parts are easily accessible, yet are fully protected against accidental damage. Write to the factory for the complete story on these new, better Penn Control Centers.

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

BULLETINS and CATALOGS

High Velocity Air Valve. Explaining how control air pneumatically activates Neoprene tubes encased in aluminum vanes, Flyer K-46 describes and illustrates Pneumavalve, a high velocity air valve that functions without air motors or mechanical linkage of any kind. Construction and performance features, including true linear modulation without hysteresis and constant relation of control to output are described. Charts of performance characteristics are provided, with dimensions and ratings for the Type PRD Single Duct model and Type DPRD Dual Duct model, and the range of sizes and their nominal cfm air delivery are given for both types.
Connor Engineering Corporation, Danbury, Conn.

Thermal System Components. Four-page Specification S690-3 describes all wet and dry bulb systems and accessories used with filled-system thermometer-psychrometers. Also included are water supply accessories for wet bulbs —wick and tank, or porous tube—and suction fans. Recorders and electric and pneumatic control models available for relative humidity are listed.
Minneapolis-Honeywell Regulator Company, Wayne and Windrim Ave., Philadelphia 44, Pa.

Production Leak Testing. Details of procedures and techniques for using halogen-sensitive leak detectors in production testing of domestic and commercial refrigeration and air conditioning equipment are given in six-page Bulletin GET-2938. Described are preparation of parts and systems for testing, calibration of leak detectors, and economical leak-searching procedures.
General Electric Company, Schenectady 5, N. Y.

Control Panel Wiring. Contained in a kit are: ten spools, each containing 200 ft of tolerance controlled color-coded insulated wire; 2000 jack-type or self contacting-type terminals for single wiring, and 200 longer terminals for split wiring; a tool for wrapping wires; a tool for seating terminals and unwrapping wires; and one wire cutting and stripping pliers. Complete instructions on use of this kit and this company's method of control panel wiring are found in a four-page bulletin. Designated the Panellogic method, it is cited as resulting in lower costs; complete color coding; wires cut to exact lengths for neater, more compact panels; taut wiring preventing accidental wire removal; visual wire tracing; complete flexibility in split wiring, with two, three, four or five-way color-coded split wires possible in any length; and tests and circuitry checks through terminal posts conducted without removing wires from panel or panel from machine.
Clarkson Press, Inc., a subsidiary of Graphic Controls Corporation, Buffalo 10, N. Y.

Air Mixing Units. Illustrations, details and dimensions of Dual-Duct air mixing units with featured automatic volume control are presented in 16-page Bulletin DD-6. Contained are detailed performance data, specifications, dimensions and arrangements of Dual-Duct systems for different types of buildings and zoning.
Buensod-Stacey, Inc., 45 W. 18th St., New York 11, N. Y.

Electric Defrost Equipment. Redesigned and expanded, this line of unit coolers for below 34 F refrigeration now features low-speed rather than 1750 rpm motors, resulting in more air with less hp through stepped-up fan efficiency. Flyer HS 842.01 presents simplified dimensional diagrams that key to performance-dimension charts. Detailed are seven standard models for Refrigerants 12 and 22, seven for ammonia service. Units in the HS series have copper tube coils, aluminum fins and silver-brazed joints, HSA models steel tube coils, steel fins and welded joints hot-dipped galvanized. Featured are automatic defrost with non-clog drain, four-blade propeller fans, heavy-channel iron hangers for remote ceiling suspension and extra coil surface.
Drayer-Hanson Div, National-U. S. Radiator Corporation, 3301 Medford St., Los Angeles 63, Calif.

Thermal Insulation Catalog. Insulations for all types of commercial and industrial requirements, in applications ranging from −400 to 3000 F, are described in 58-page Catalog IN-244A. Six complete sections, each concerning a specialized group of insulations, are contained: industrial and high temperature; plumbing, heating and air conditioning; refrigeration; insulating firebrick and refractories; finishes and weatherproofing materials; and miscellaneous insulations, including asbestos papers, millboard, felts, blankets and similar products. Sections are thumbtabbed for easy reference. Information on each product consists of an application illustration, description, available forms or types, advantages to users and detailed specification data, including compliance with government specifications and ASTM standards. Type of insulation and its temperature limit for each product are displayed.
Johns-Manville Sales Corporation, 22 E. 40th St., New York 16, N. Y.

Conversion Charts and Technical Data. Contained in a six-page folder are: altitude-pressure table, two tables indicating the difference between wet and dry bulb readings in F and C, a temperature conversion chart, specific heat of various substances, and conversion chart for weight, velocity, density, heat transfer and vacuum equivalents.
Conrad, Inc., Holland, Mich.

Gas Conversion Burner. Describing and illustrating this unit, an inshot model called the Tele-Tube, is a flyer. Noted is the burner's adjustable venturi, which telescopes from 6½ to 13½ in. to fit most existing furnace and boiler installations. According to the manufacturer, gases are mixed with air in the Tele-Tube, then forced into the furnace horizontally where they are deflected downward at a 17 deg angle, producing 50,000 to 225,000 Btu, enough to heat a 12-room home.
Barber Manufacturing Company, 1052 E. 134th St., Cleveland 10, Ohio.

Circular Diffusers. Product information, specifications and performance charts on the Silentair series are organized for easy reference in 16-page Bulletin C-600.
General Air Products Corporation, 14 Factory St., Cedar Grove, N. J.

Industrial Thermometers. Air duct and moisture-proof models, together with an easily positioned MultiForm model cited as saving engineering and installation costs and reducing stocking requirements because it adjusts and locks in any required form or angle to by-pass piping for better visibility, are the subjects of four-page Bulletin F2. Aluminum alloy case Air Duct Thermometers feature bare bulb protected by perforated stem for

greater sensitivity and quicker response. Moisture-Proof or "severe service" Thermometers are designed for use outdoors on pipe lines, tanks and trucks or for conditions of severe vibration as on diesel engines.
Precision Thermometer & Instrument Company, 1434 Brandywine St., Philadelphia 30, Pa.

Solenoid Valves. Cross-sectional diagrams as well as product illustrations are included for a complete line of electrically controlled magnetic solenoid valves, in a 20-page catalog. Comprising the valve line are normally closed and normally open solenoid valves used primarily for the control of water, oil, steam, air, solvents, gas and chemicals.
Magnatrol Valve Company, 60 Fifth Ave., Hawthorne, N. J.

Refrigeration and Air Conditioning Products. Included in 20-page Catalog R-7 is complete information on line, globe, relief and check valves; heat exchangers, SAE flare fittings and related brass products for the air conditioning and refrigeration industries. Detailed information on sizing and application of valves and components, with added data on working pressures and descriptions of the codes and regulations to which the products are manufactured, is also contained.
Superior Valve & Fittings Company, 1509 W. Liberty Ave., Pittsburgh 26, Penna.

Infra-Red Gas Heaters. Detailing applications of this manufacturer's line of infra-red heaters and presenting information on individual models is a series of three four-page Bulletins, CS 300, CS 305 and CS 306, and three Flyers, CS 301, CS302 and CS 304. Units described include patio, shallow and deep parabolic and portable models.
Perfection Industries, Div of Hupp Corporation, Cleveland 10, Ohio.

Urethane Foams. Blowing urethane foams with fluorinated hydrocarbons, a method which is growing in popularity because of the economy and uniformity of foams it produces, is presented in four-page Bulletin IR-229, "Blowing Foams with Isotron". Because Isotron is used as an integral part of the urethane formulation and produces the plastics' cellular structure as it vaporizes at its low boiling point (75 F), its adoption in foam making eliminates the need for gas generating equipment. Foaming action can be controlled, pore size is uniform and foams cure faster. In

addition to discussing these advantages, the bulletin points out that Isotron-produced foams have low heat conductivity, wide range of densities, great moisture resistance and good adhesion to retaining walls. A chart comparing physical properties of the most widely used insulating and cushioning materials and technical data on Isotron is included.
Pennsalt Chemicals Corporation, 3 Penn Center, Philadelphia 2, Pa.

Water Conditioning. Covering bacterial fouling, deposits encountered and operational factors, this water conditioning data sheet, "Care and Operation of Zeolite Softeners", also discusses how exchange materials should be handled to maintain maximum efficiency and longer equipment service life.
Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 24, Pa.

Ventilating Fans. Model 5508 for ceiling and Model 5518 for wall-type ventilation are illustrated and described in 4-page Bulletin 271-L. Design, installation and operational features are mentioned. One page of the bulletin is concerned with accessory items, and illustrates other fans in this manufacturer's line.
Air Control Products, Inc., Leigh Building Products Div, Coopersville, Mich.

Hydrocarbon Detector. A completely self-contained portable instrument for rapid measurement of total organically bonded carbons in atmosphere or gases, Model 213 is described in an eight-page bulletin. Typical applications of the unit include measurement of unburned hydrocarbons in exhaust gases and low-level hydrocarbon contamination in liquid oxygen used in missiles, and atmospheric monitoring in air pollution. Operation, use and specifications of the instrument are described.
Perkin-Elmer Corporation, Norwalk, Conn.

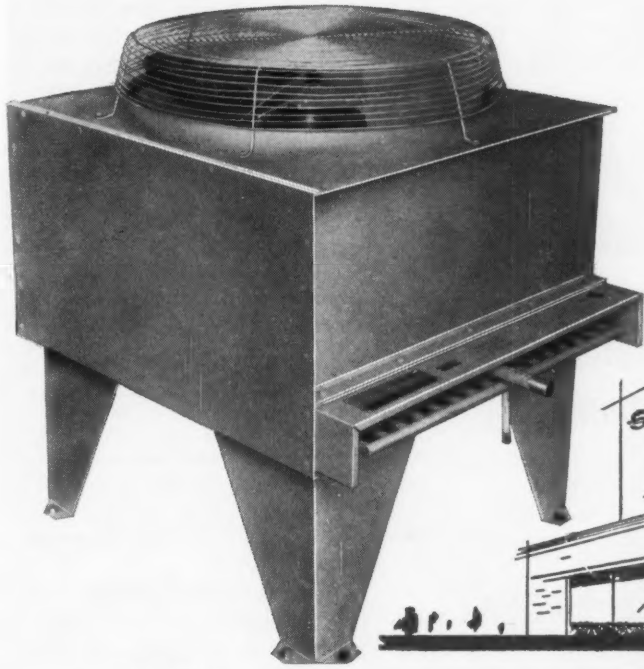
Coil Manual. In addition to specifications, drawings and installation instructions, this manual includes direct selection tables for three types of steam coils, two types of booster coils, two types of water heating coils, three types of water cooling coils and four types of direct expansion coils.
Bohn Aluminum and Brass Corporation, Danville Div, Danville, Ill.

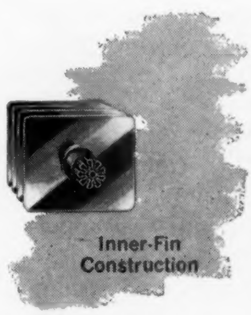
Pneumatic Temperature Control. Suitable for operation at temperatures up to 2000 F, Model OA is a differential expansion-type controller. Essentially

shaped for '60 . . .

the NEW DUNHAM-BUSH 'LSBC'

...a Low Silhouette Blower Condenser that offers high performance and exceptional installation flexibility





The shape of the Dunham-Bush 'LSBC' really has a function . . . the low lines of this new air cooled blower condenser give it an important application/installation superiority over similar units of different design.

Because its new engineered shape ensures safe pounds-per-square-foot loading, the 'LSBC' can be installed virtually anywhere on any roof, without the costly reinforcement of roof members usually necessary to support heavier units. And, the low, compact 'LSBC' is easily accommodated within minimum space, yet has the operational and construction features to meet the most rigid performance demands. Air movement is up and out, meaning minimum noise rating.

Other major features include a high efficiency inner-fin condenser coil with less internal volume and therefore smaller refrigerant charge . . . drip-proof, NEMA frame, grease-lubed ball bearing type motors, with an adjustable base to facilitate belt tension adjustment.

The 'LSBC' is available in a variety of circuits. Models range from 5 to 53.5 tons.

For further information, write for Form No. 7011-1, or call the Dunham-Bush sales engineer near you.

Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA

MARSHALLTOWN, IOWA • RIVERSIDE, CALIFORNIA

SUBSIDIARIES

a temperature transmitter, it provides air pressure proportional to temperature and is used for direct operation of air-operated diaphragm valves, motors, dampers or similar equipment. Flyer 152.
Burling Instrument Company, 16 River Rd., Chatham, N. J.

Ammonia System Controls. Replacement part kits for those thermostatic expansion valves and solenoids which can be serviced in the field are tabulated for convenience in ordering, and detailed specifications, application and construction data is included for all ammonia controls, in 12-page Bulletin 25-1059.
Sporlan Valve Company, 7525 Sussex Ave., St. Louis 17, Mo.

Recording Oscillograph. Subjects covered in 16-page Bulletin 1500 include evaluation by dynamic testing, description of the 18 or 26-channel oscillograph, specifications and features, description of the rapid access magazine and other accessories and a table of specifications for galvanometers.
Consolidated Electrodynamics Corporation, 360 Sierra Madre Villa, Pasadena, Calif.

Multi-Pointer Gage Units. Used for pressure and level measurements and pneumatic transmitting or receiving, these instruments are described and illustrated in 4-page Bulletin M42-2. An actual size drawing of the seven-in. indicating scale is included to illustrate easy readability.
Bailey Meter Company, 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Air Conditioning and Refrigeration Equipment. In its 36 pages Bulletin 80-F presents tables, uses of this equipment, product illustrations, various installations and complete information on this manufacturer's line of air conditioning and refrigeration equipment. Included are compressors, booster systems, condensers, coils and coolers, air handling units, control equipment, valves and fittings, industrial processes, quick-freezing systems, block-ice systems and shell-ice makers.
Frick Company, Waynesboro, Pa.

TECHNICAL DIVISION

(Continued from page 75)

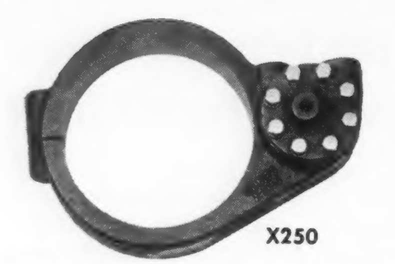
becomes 8.7 and TC 6.1 becomes 8.8.

While this discussion indicates that reorganization of the Technical Division has been straight forward, problems are certain to arise. In solving these problems, Committee Chairmen and Coordinators should keep in mind these two statements of policy:

1. Conduct the transition in such a way as to insure minimum disruption of Committee work in progress.
2. Retain all personnel willing and able to contribute to the activities of the Technical Committee organization.

All Group Coordinators and TC Chairmen of the Technical Division will receive letters of invitation from Dr. Jordan. These Chairmen should organize their committees without delay. Should any questions arise, they may be referred either to me or to Andrew T. Boggs III, Technical Secretary.

Organization of the Technical Committees is flexible and committees may be added or deleted from the R&T structure as required by Society activities. A complete listing of TC's, including membership of each, will appear in a future issue of the JOURNAL.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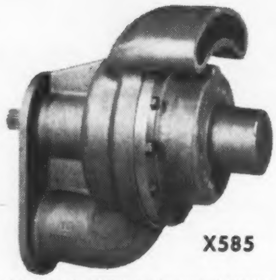
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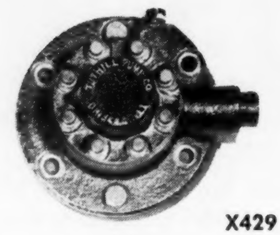
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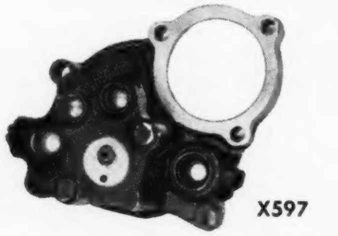
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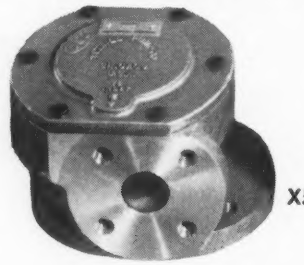
for those special applications . . .

TUTHILL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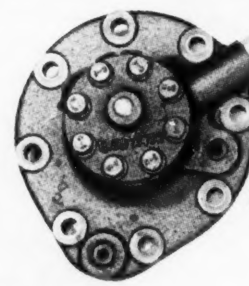

X476

fits the pump to the PROBLEM

Here you see seven pumps . . . each designed to provide the best possible answer to one specific problem. They are typical of the many special application pumps developed each year at Tuthill.

For, while Tuthill offers over 800 standard models, often a customer's particular requirements indicate the desirability of special features not included in the standard line. For these applications Tuthill attempts to develop a pump to fit the problem . . . not require the user to modify his problem to fit a standard line.

Special housings

The seven examples shown indicate Tuthill's versatility in developing special housings for different types of equipment. For example, number X250 above was designed to provide a pump for a hydraulic actuator on a machine tool. The most convenient place to install this pump was on the hydraulic column . . . so the special mounting shown was designed. Most of the other unusual shapes shown above were similarly devised for greater convenience and lower assembly costs in building a pump into a particular piece of equipment.

Special materials, shafts, gearings

This versatility of housings and mounting arrangements only begins to indicate Tuthill's ability to best meet the requirements of a given application. As another example, models number X543 and X585 have bronze outer construction, and other features which particularly qualify them for marine applications. Model X429 above incorporates Tuthill's special automatic reversing feature. This means the pump may be driven from a reversing shaft . . . or provides for applications where a machine must be shipped without knowing the ultimate direction of the driving unit.

Tuthill pumps may be supplied with a wide variety of shaft seals for use with various fluids. They can incorporate strainers, as model X585 above. They may be provided with, or without, built-in relief valves. They can incorporate a wide variety of special shaft modifications or gearing to accommodate various driving units.

They may be provided with steam jackets for use with viscous fluids. They may be also shipped as stripped models that can be built right into your equipment.

Tuthill's experienced application engineers will be happy to show you how Tuthill can develop a pump to fit the requirements of your particular application. Write today for a copy of catalog 100.

Tuthill manufactures a complete line of positive placement rotary pumps in capacities from 1 to 200 GPM; for pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

969 East 95th Street, Chicago 19, Illinois

Wagner Vertical Solid Shaft Motors . . .

POWER PACKED PUMP DRIVES

Got pump-power problems? You can solve them—simply, easily—with Wagner Vertical Solid Shaft Polyphase Motors. These motors are designed especially to meet the load conditions of pumping. They handle loads without laboring or stalling . . . are smooth running under cyclic loads. They are uniquely suited, too, for other types of equipment that require vertical motor drives. Match them to agitators, axial fans, centrifuges, mixers, presses . . . anywhere you need a vertical shaft motor.

Whatever the application, one thing is sure . . . Wagner advanced design engineering has produced vertical shaft motors of simple, rugged cast-iron construction . . . motors with plenty of stamina to give you economical, maintenance-free service the year 'round, indoors or out.

Wagner Vertical Solid Shaft Motors are end-mounted, squirrel-cage type with NEMA Type "P" base. They are available in standard ratings of 60 cycle, 208-220/440 and 550 volt, 1½ through 40 hp—3500 RPM, and 1 through 30 hp—1750 RPM. For information on larger horsepower ratings, call your nearby Wagner Sales Engineer.

Other motor requirements? Wagner can supply standard motors or build special motors to fit your needs. More than 65 years of constant research and development in electric motor design has made Wagner a name you can depend on. For an analysis of your next motor application, be it for plant or product call on Wagner. There are 32 branch offices in principal cities across the country.

Wagner Electric Corporation
6379 Plymouth Ave., St. Louis 33, Missouri

WH60-4

SERVING 2 GREAT GROWTH INDUSTRIES — *ELECTRICAL — AUTOMOTIVE*

REVOLUTIONARY

Stafoam*

SAVES UP TO 25% ON TANK INSULATION COSTS!

INSTALLS IN LESS THAN 1/2 THE TIME

Stafoam, in its flexible blanket form, is applied to indoor or outdoor storage tanks faster, more economically than other thermal materials . . . installs in less than half the time needed for traditional materials . . . gives superior insulation at an end cost of up to 25% less.

An improved urethane, Stafoam blankets are bonded to the bare surface of the tank. If blankets with facing are used, the job is complete. Blankets without facing are finished with coats of "breathing" or vapor barrier mastic. The type of mastic is determined by the temperature system of the tank.

Versatile Stafoam has a very low K factor between −100 and +250°F, unusual strength and acoustical characteristics, and is inert to most chemicals. In flexible blankets, rigid slabs, or foamed-in-place it insulates hot or cold walls, encases tanks, muffles sound and heat from engines or machinery, sheaths valves from corrosion, and so on. Its possible applications seem unlimited.

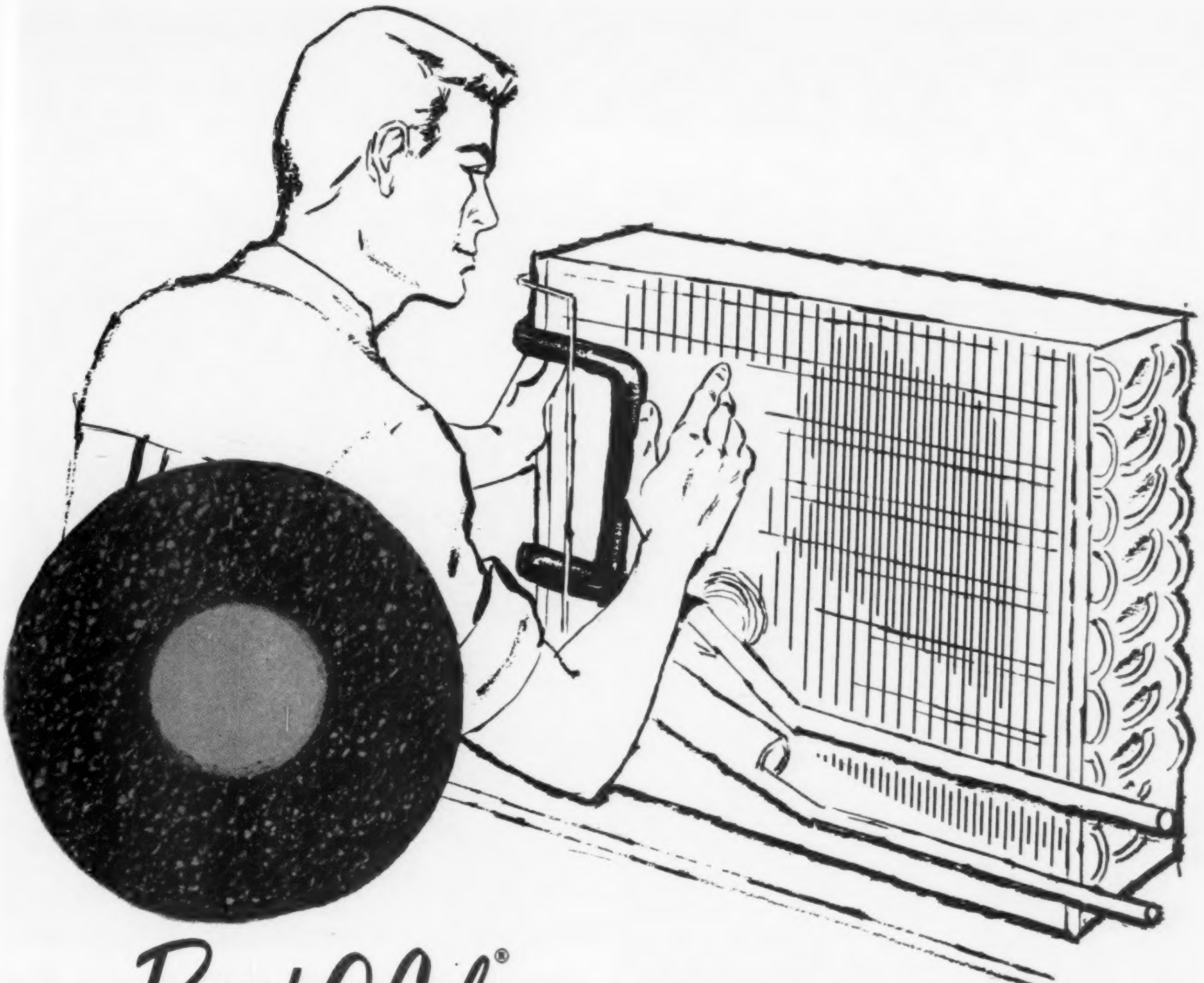
Dayton Rubber, with its years of experience in urethanes, controls weight, strength, density and texture at will . . . can custom formulate to specifications. For complete information about Stafoam flexible, slab or foamed-in-place insulation, call or write The Dayton Rubber Company, Urethane Division, Dayton 1, Ohio.

**Registered Trade Mark*

stafoam®

made by THE DAYTON RUBBER COMPANY, Dayton, Ohio and its West Coast Division, AMERICAN LATEX PRODUCTS CORPORATION, Hawthorne, California

HEADQUARTERS FOR NEW IDEAS



New *Presst-O-Cel*® guards against condensation and "sweating". . . insulates . . . provides vapor barrier

This new lightweight neoprene tube and pipe insulation is made up of millions of tiny inert gas-filled cells with the result that it forms an effective wall against heat, cold or moisture wherever it is used.

Because it is so light and flexible, it makes an ideal material for covering tubes and pipes subjected to temperature or humidity conditions that might cause condensation or pose heat-loss problems—as on air conditioning and refrigeration lines.

In spite of its lightweightness and softness, PRESST-O-CEL offers long-life durability: it is water and air tight; resistant to oil, acid and alkali; self-extinguishing; will not support fungus; resists rodents and vermin and has a high insulation factor.

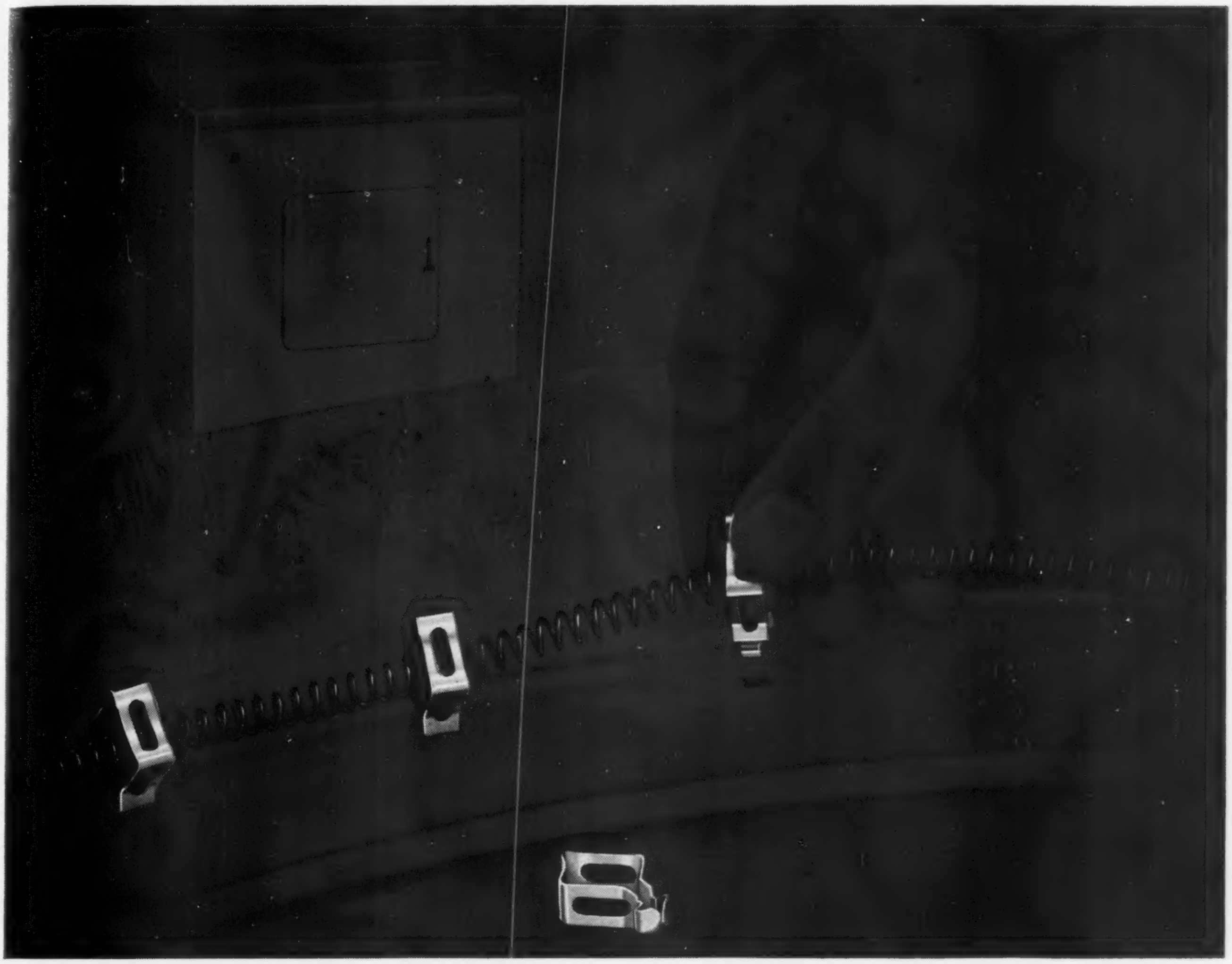
WRITE for more information on this amazing new product.
A free sample is also yours on request.

PRESSTITE Sealing Compounds

PRESSTITE DIVISION
AMERICAN-MARIETTA COMPANY

K A P

3790 CHOUTEAU AVENUE • ST. LOUIS 10, MISSOURI



Engineered by Tinnerman . . .

SPEED CLIPS® reduce costs, simplify assembly and servicing on Maytag "Halo of Heat" Dryer

Clothes are dried efficiently in the famous Maytag "Halo of Heat" automatic dryer. And now the quality of the "Halo of Heat" dryer is even better than ever because its unique circular heating element is fastened quickly, securely by 22 special Tinnerman SPEED CLIPS developed by joint efforts of Tinnerman and Maytag designers.

Each one-piece SPEED CLIP eliminates a separate welding operation on the "Halo of Heat" assembly. Various screw-driving operations formerly required on Maytag's assembly line to capture the ceramic insulator and secure the mounting clamp were also eliminated, with equally interesting reductions in cost. Now, the stainless steel, vibration-proof fastener is snapped in place with simple "button-hook" action. No special skills or equipment are required. Assembly and parts costs have been reduced... *substantially!* Serviceability in the field has been improved.

A free Tinnerman Fastening Analysis of your own product can show you where similar assembly and cost-saving advantages are possible. Call your Tinnerman representative—he's listed in the Yellow Pages under "Fasteners". Or write to:

TINNERMAN PRODUCTS, INC.
Dept. 12 • P. O. Box 6688 • Cleveland 1, Ohio

TINNERMAN
Speed Nuts®

FASTEST THING IN FASTENINGS®

CANADA: Dominion Fasteners Ltd., Hamilton, Ontario. GREAT BRITAIN: Simmonds Aerocessories Ltd., Treforest, Wales. FRANCE: Simmonds S.A., 3 rue Salomon de Rothschild, Suresnes (Seine). GERMANY: Mecano-Bundy GmbH, Heidelberg.

mp ontrol installation
ith Honeywell men on the job!"

ll-mounted thermostats in every private office en-
e employees to dial the exact temperature they prefer.
d in each of the buildings' working spaces, strate-
ally placed thermostats assure comfort no matter
at the activity.

Honeywell Engineers working on the air conditioning system at the distinctive new Flick-Reedy power cylinder plant, installed the exact control system needed for one of the world's largest heat pumps!

"The job of harnessing this huge heat pump was mighty important to us," says Mr. Flick. "Our plans called for a customized temperature control system which would assure the welfare of our employees, and solve certain critical production problems. It was a large order, but Honeywell Engineers, working with the York people and Zay Smith and Associates Engineers, solved the problem to our complete satisfaction."

Air conditioning this 220,000 square foot plant presented some unusual problems. The entire work area is fully air conditioned—including the welding, heat treat and plating areas. And, the entire system is completely automatic. A Honeywell Supervisory DataCenter* (shown in background) monitors the heat pump and controls temperatures in every zone.

In addition, every private office and conference room is equipped with its own Honeywell Round thermostat.

As the leader in temperature control for 75 years, Honeywell is well equipped to help you solve your clients' most critical temperature control problems. Call your nearest Honeywell office today. Or, write Minneapolis-Honeywell, Minneapolis 8, Minn.

**Trademark*

Honeywell

H HONEYWELL *First in Control*

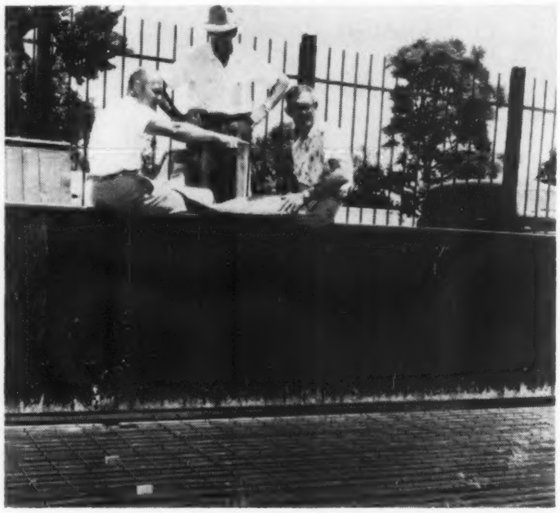
SINCE 1885

75th YEAR PIONEERING THE FUTURE

Applications

SKATING RINK TESTED WHILE IN USE

Shown before its concrete base was poured, Columbus, Ind.'s, Lincoln Center Ice Rink exhibits a section



of its grid of refrigerant-carrying steel pipe. Manufactured by National Supply Company, the 12 mile of pipe is 1¼-in. diam and is laid on 3½-in. centers. For the 1958-59 season, water was sprayed directly over the grid pipe to form ice, so that the rink could be tested through use. When end-of-season inspection showed that the pipe was holding up, concrete was poured over it to form a permanent base.

Refrigeration equipment for the Center, which consists of two rinks measuring 85 x 185 and 85 x 40 ft, is comprised of three Beltemp B-60 Icemakers, each having a 100-hp motor driving six seven-cylinder radial type compressors. Instead of brine, the rink uses a newly-developed anti-freeze solution with a neutralizer. Three 20-hp pumps circulate the solution through the feeder lines to the grid pipe. The ice is usually maintained at about zero F, with each rink separately controlled so that ice can be formed on one without freezing the other.

AIR CONDITIONING MAINTAINS EQUIPMENT CALIBRATION

Buildings No. 1 and 3 of the new Avco Research Center at Wilmington, Mass., the Research and Development Buildings, house various laboratories, offices, darkrooms and machine shops. In addition, Building 3 contains special laboratories that require close control of temperature and humidity and a mathematics section that includes an IBM 704 computer. Many of the laboratories use electronic equipment that lose their calibration if operated in ambient temperatures


IT'S ALWAYS "WINTER" SOMEWHERE!

exceeding 80 F. For this reason, the building design conditions are 76 F and 50% relative humidity.

Floors of these buildings are 50% on grade and 50% elevated, so as to be exposed partially to the atmosphere. Large interior light wells, approximately 50 x 75 ft, required treatment of almost all areas as exterior zones when designing the air conditioning system, while continuous six-ft high windows are in all exterior walls, greatly increasing heat loss or gain.

Solving these problems is a split system with baseboard convectors compensating for the window heat loss and a low velocity air system carrying the balance of the load. Central air handling equipment was built-up on the site from Trane Company fans and heating and cooling coils. Air is returned to the central equipment room through strip air grilles located in the ceiling at the exterior walls, a location selected to remove the large heat gains from the window blinds before this heat could enter the occupied space. To compensate for future requirements, air supply diffusers are located on a modular spacing to allow for relocation of partitions, and those zones which presently are loaded lightly are furnished with oversized cooling coils to allow for possible increase in load.

During the spring and fall months, an economizer cycle is utilized to circulate outdoor air when neither heating nor cooling is required.

Each zone duct is furnished with heating and cooling coils to maintain space conditions. Chilled water is furnished by one Trane Hermetic CenTraVac in each of the buildings and hot water by steam converters. This hot water is supplied to the baseboard at 200 F and to heating coils at 140 F, and is temperature-controlled by a three-way mixing valve, bypassing a portion of the return water around the steam converter to maintain the desired temperature. Steam pan humidifiers maintain humidity in winter.

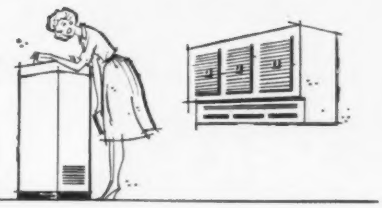
Special laboratories which require close control of temperature and humidity are served by separate fans with duct-mounted zone heating and cooling coils and spray humidifiers. The mathematics section is also handled as a separate system, with the IBM computer serviced by two independent systems. One system supplies conditioned air to the individual machines by under-floor ducts, while a second conventional ceiling distribution system maintains room conditions as required by the equipment. This double system, which uses a Trane Cold Generator, reduces the cooling load in the space and reduces drafts by reducing supply air requirements.

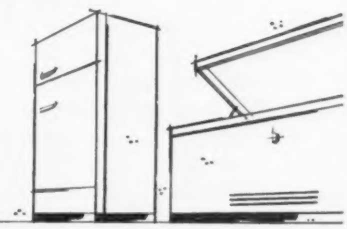
AUTOMATIC SNOW REMOVAL SYSTEM SERVICES DETROIT BANK

Installed in the sidewalks bordering the National Bank of Detroit is an extensive automatic snow removal system, covering approximately 26,000 sq ft, including the bank building's steps and arcade.

One-in. diam Byers 4-D wrought iron pipe grids in the steps are laid on eight-in. centers, while the sidewalk snow melting piping is laid on twelve-in. centers. All headers are two-in. diam. A vermiculite fill of three and one-half to four in. was placed beneath

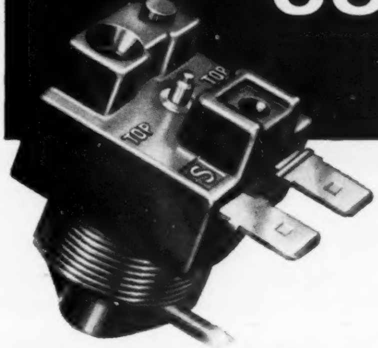
Protect Product Reliability

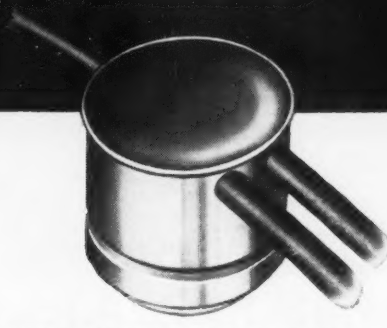


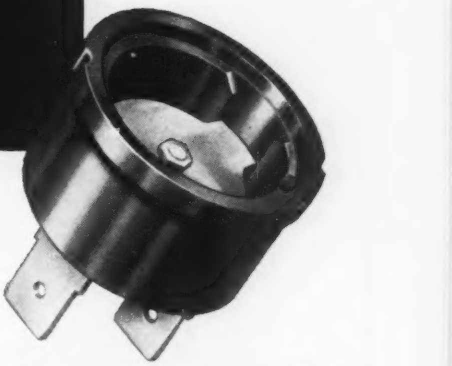


with Dependable and Economical

KLIXON Refrigeration CONTROLS*







KLIXON Motor Starting Current Relays† complete the combination required to start and protect compressor motors. Their positive action over a wide range of voltage and long life eliminates starting troubles.

KLIXON Hermetically Sealed Thermostats give reliable temperature control unaffected by frost, moisture, altitude or cross-ambient effect . . . available for heating or cooling applications.

KLIXON Dome Mounted Protectors† permit maximum safe compressor performance under all conditions of load . . . shut the motor down when maximum allowable winding temperature is reached . . . automatically restart it when operation can be continued safely.

These reliable KLIXON Controls provide manufacturers with the utmost in compressor protection and unit control. They help you protect your investment by maintaining quality product reputation through dependable operation, even under adverse conditions.

Your dealers benefit, too, because KLIXON Controls assure trouble-free performance throughout the years. The result — long compressor life, reduced service calls, less factory returns for repairs and replacements.

Manufacturers of hermetic or open type compressors and builders of complete refrigeration, heating and ventilating equipment are invited to find out more about KLIXON Controls.

†Replacements are available through distributors.

**Over 200,000,000 KLIXON Controls are in use in refrigeration and heating equipment.*

SPENCER PRODUCTS

TEXAS INSTRUMENTS
INCORPORATED
METALS & CONTROLS DIVISION
3702 FOREST STREET • ATTLEBORO, MASS.

Spencer Products: Klixon® Inherent Overheat Motor Protectors • Motor Starting Relays • Thermostats • Precision Switches • Circuit Breakers

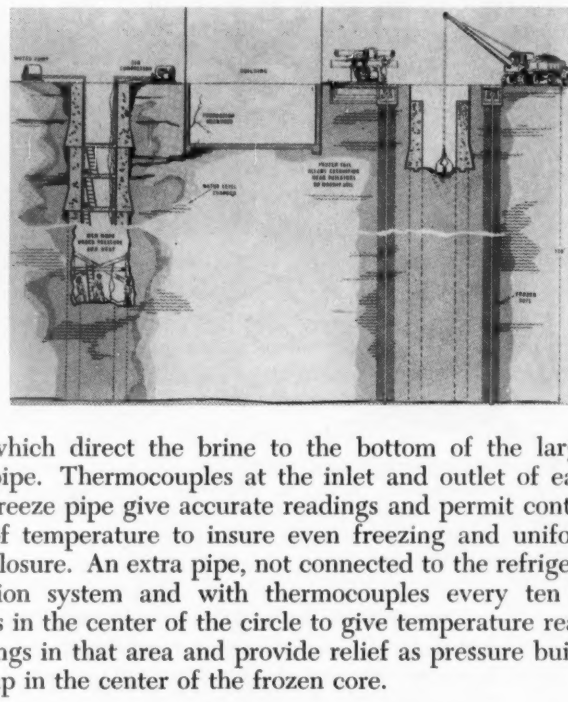
pipe to retard downward heat loss and the six-in. concrete slab containing the snow melting grids has three and one-half in. of concrete above the pipe and two and one-half in. below.

Air tested for 24 hr, the system will utilize a solution of 40% ethylene glycol, 59% water and 1% rust inhibitor in operation. Steam used to heat the circulating fluid will be supplied by Detroit Edison's Central System.

GROUND FREEZING SYSTEM USED IN EXCAVATION

An artifically frozen column of marshy soil, 123 ft deep and more than 40 ft diam, is being used to sink a vertical shaft on the banks of the East River in New York City. After striking bed rock, the shaft will continue down and under the river to Brooklyn as part of the Newtown Creek Pollution Project. Use of the ground freezing method was dictated by the necessity of avoiding any lowering of the water table or movement of sub-surface formations that could endanger foundations of nearby buildings.

Heart of the operation consists of two 55-ton reciprocating ammonia brine chillers, supplied by York Div, Borg-Warner Corporation. Brine at 17 F is supplied by this system to 21 pipes arranged in a circle 26½ ft diam. The six-in. pipes are arranged approximately four ft apart and contain two-in. center pipes



which direct the brine to the bottom of the larger pipe. Thermocouples at the inlet and outlet of each freeze pipe give accurate readings and permit control of temperature to insure even freezing and uniform closure. An extra pipe, not connected to the refrigeration system and with thermocouples every ten ft, is in the center of the circle to give temperature readings in that area and provide relief as pressure builds up in the center of the frozen core.

HARBOR WATER USED TO CONDITION SKYSCRAPER

Tunnelling horizontally 300 ft from the building site through solid sandstone to the harbor, engineers working on this 26-story building, under construction in Sydney Cove, Australia, will supply sea water to the building's refrigeration plant at the rate of approximately 180,000 gph. In winter, this plant will cool the sea water, trapping the heat removed during this

process, which is expected to produce the equivalent of 1,500,000 watt of electrical heating each day.

Worthington centrifugal refrigeration equipment, with a capacity of 1300 hp, will produce 500 ton of refrigeration per day during summer and will be switched automatically to the heat pump cycle during colder weather. Air conditioning equipment will be on the 13th floor, with the main refrigeration plant in the sub-basement. Distribution of air through the building will be by high-velocity and medium-velocity air ducts totaling 40 mile in length.

INSULATION TO AID REDUCTION OF MOTEL HEATING COSTS

Through the use of glass fiber insulation, heating costs in a Michigan motel are expected to be substantially reduced. More than 23,000 sq ft of the material, a product of Zonolite Company, was used in the two-story, 37-unit building, installed in all exterior wall areas and in walls between units, in two three-in. layers. In addition, the insulation was used to wrap vents and pipes in the ceiling areas and placed under the floors of second story units above car entrances and exits. A fine-fibered wool blanket with an aluminum vapor barrier, the material also is sound-absorbent, acting to noise-proof the motel.

GAS PROVIDES ALL SUPERMARKET AIR CONDITIONING REQUIREMENTS

All refrigeration equipment in this Arkansas supermarket, except sub-zero frozen food and ice cream cases, is cooled by a gas engine-driven compressor. Refrigerated by this system, designed by Arkansas Louisiana Gas Company, are two walk-in coolers, a 36-ft meat case, a 24-ft vegetable case and a 12-ft, triple-deck dairy case, a total of approximately nine ton of refrigeration. Thirteen ton of comfort cooling for the 5000-sq ft customer area is also provided by the compressor.

Refrigerant 12, condensed to liquid in an evaporative condenser, is distributed to the food preservation equipment via individual refrigeration lines running through a floor trench to each group of cases; the expanded gas is returned to the compressor by a suction piping system. A control system automatically actuates the compressor to satisfy refrigeration demand in any part of the store, stopping the gas engine in case of a malfunction or when the demand is satisfied. Provision is made for timed defrosting of each group of cases; the walk-in coolers are manually defrosted. Automatic changeover from summer to winter operation is achieved by an outdoor thermostat circuit.

Year-round air conditioning is provided by one central air handling unit suspended above the ceiling at the rear of the store. A direct expansion coil furnishes the 13 ton of cooling with two-stage thermostat control. Winter heating is supplied by a small hot-water coil, the hot water being circulated to the coil from a package boiler in the equipment room. A duct system above the ceiling distributes cool and warm air through diffusers throughout the building.

CLASSIFIED ADVERTISING

RATES—Classified advertisements at this heading are inserted in 8-point type at the rate of $1.00 per line or fraction thereof, including heading and address. Eight words to the line average. Box number address counts as one line. Minimum insertion charge, 5-line basis. Maximum insertion 10 lines. Prices are net, no discounts. Box number replies promptly forwarded without charge. Available Engineers insertions up to 60 words for Full and Associate members, and Affiliates are carried free.

NO DISPLAY advertising at this heading.

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OPENINGS

REFRIGERATION SALES ENGINEER—Rapidly expanding, West Coast-headquartered industrial refrigeration manufacturer offers opportunity for aggressive sales engineer. Must have engineering degree or equivalent; minimum of 3 yr refrigeration sales engineering experience in quick freezing, cold storage and process refrigeration. Excellent salary, commission, outstanding company benefits, car allowance and expenses. Send resume or phone C. R. Kohlenberger, Pres., Kohlenberger Engineering Corp., 1600 W. Commonwealth Ave., Fullerton, Calif.

MECHANICAL ENGINEER—Excellent opportunity for Project Manager, Project Engineers, and Design Section Chiefs experienced in design of heating, ventilating, air conditioning, piping, power plants. Wide variety of work (including client contact) with established Midwest consulting firm. Permanent. Good starting salary, advancement, and vacation program. Moving expenses paid. All replies answered. Box 923, ASHRAE JOURNAL.

EXPERIENCED EXECUTIVE wanted. Capable of successfully operating Sheet Metal Shop and Contracting Business. New York Metropolitan area location. Excellent opportunity. Reply stating all pertinent information. Box 936, ASHRAE JOURNAL.

AVAILABLE

AIR CONDITIONING & HEAT PUMP ENGINEER—22 yr experience. Window type and residential air conditioning package systems, heat pumps, systems design, unit coolers, heaters, finned coils. Thoroughly familiar with design, testing, production methods, tooling, purchase specifications. N.Y.P.E. license. Prefer Western New York State location. Box 869, ASHRAE JOURNAL.

MECHANICAL ENGINEER—P.E., 9 yr experience in supervision, design, specification, client contact in HVAC and plumbing work. Desire to locate in Southwest. Box 925, ASHRAE JOURNAL.

AIR CONDITIONING and HEATING ENGINEER—BSME '39. Member ASHRAE, 20 yr experience including factory superintendent, product sales manager, 7 yr field experience as district sales manager for packaged air conditioning equipment (commercial and residential), heating equipment, and central station applied equipment, desires responsible position with manufacturer, contractor, consultant, or distributor in Philadelphia area. Salary minimum $10,000 per year. Box 931, ASHRAE JOURNAL.

DOMESTIC REFRIGERATOR ENGINEER — P.E., BSME, member ASHRAE. 10 yr successful experience in design and test of cabinet components, systems, and overall thermal design for product line. Now Head of Engineering Test Laboratory. Desire job with greater responsibility and managerial growth potential in same or related field. Minimum salary required $16,000. Resume upon request. Box 932, ASHRAE JOURNAL.

AIR CONDITIONING ENGINEER—P.E. with B.S.M.E. degree, Heating, Plumbing, Refrigeration Engineer, 14 yr. experience in industrial, commercial, high rise buildings, refrigeration plants. 8 yr as Sr. Design Engineer and Squad Leader with leading Architectural firms. Desire position as Chief or Assistant Chief Engineer with small, progressive Architect or Consultant. Chicago area preferred, but will relocate. Resume available. Box 933, ASHRAE JOURNAL.

MECHANICAL ENGINEER—B.M.E., P.E., 39 yr old, member ASHRAE, competent to handle entire HVAC and Plumbing section. Experience consists of supervision, design, system analysis, client contact field work and specifications for all types of commercial, industrial and military installations. Box 934, ASHRAE JOURNAL.

REFRIGERATION ENGINEER—2 yr college, 22 yr in industry, full member ASHRAE. Excellent background in sales, service, application and installation all sizes of heating and cooling equipment including heat pumps. Desires responsible position in air conditioning field, will relocate. Box 935, ASHRAE JOURNAL.

ENGINEER—Businessman with over 15 yr experience in sales, business, engineering, marketing, administration in air conditioning and refrigeration. Desires working and financial association with reputable manufacturer, distributor or contractor in NYC general area. 35 yr old, married, energetic. Education M.S., B.S.M.E., and general business. Resume on request. Box 937, ASHRAE JOURNAL.

REFRIGERATION ENGINEER — Thoroughly experienced in administration, design and operation of large warehouse and marine refrigeration. M.I.T. graduate and ASHRAE Associate Member, now 34, seeks opportunity at administrative or full engineering level. Box 938, ASHRAE JOURNAL.

AN INDEX TO THE ADVERTISERS